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DIRECTOR OF ARMY AVIATION, ACSFOR DEPARTMENT OF THE ARMY
BG James H. Merryman

COMMANDANT, U. S. ARMY AVIATION SCHOOL
MG William J. Maddox Jr.

ASST COMDT, U. S. ARMY AVIATION SCHOOL
COL (P) James M. Leslie

EDITOR, U. S. ARMY AVIATION DIGEST
Richard K. Tierney

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**The nose pitched down,
the aircraft began spinning...**

Oh, Those Unsafe Acts!

CW2 Charles D. Schenck

BOOM! It was like an explosion. For some reason though I knew immediately what it was. We had lost our tail rotor. The nose of the UH-1H pitched down and the aircraft slowly began spinning to the right. We were descending fast. I rolled off the throttle and reduced some collective. It didn't do any good. We continued spinning faster and faster out of control. I still shudder remembering the helplessness I felt as we fell. I thought to myself that this was it. My life was to end in a stinking rice paddy in the Republic of Vietnam.

The aircraft hit the ground nose first. Then the blades began striking the ground nearly bring the transmission and blades down on top of us. Suddenly everything was quiet. All that could be heard were the inverters. I was alive! I looked around quickly. Everyone had survived but fuel and hydraulic fluid were pouring in. I yelled, "Get out!"

No one wasted any time taking that advice. In fact, until that day I had never seen anyone walk on water. After turning the battery and fuel off, the aircraft commander and I weren't far behind our passengers and crew. A quick check showed no one was hurt seriously. The aircraft, however, was a total loss.

The story I've told you so far is true, but it's not the whole story. Something should have entered your mind by now. What caused this accident? What could have been done to prevent it? Well, there are a couple of answers to both questions.

The accident board attributed the cause to maintenance error. One of the tail rotor blade retaining nuts had not been safetied and torqued as required in the maintenance manual. Consequently, the blade fell off causing the remaining blade to strike the vertical fin and rip out the gearbox. In answer to the second question, the board recommended closer inspection during tail rotor assembly. Basically the board's findings were accurate, but in retrospect I don't think they were complete. To explain I'll have to go back a short time before the accident.

We were operating out of a field site known as Landing Zone (LZ) Baldy about 20 miles north of Chu Lai, Republic of Vietnam. Our unit, the 54th Dustoff, was located at Chu Lai. The medical company at LZ Baldy asked us to transport six ambulatory patients to the hospital at Chu Lai. We loaded the patients and took off. About halfway to Chu Lai we decided to stop at a small fire base and pick up a couple more patients. As we were on final approach to the medical pad a CH-47 cut in front of us to land at the resupply pad. In order to avoid overtaking him we reduced air speed to 10 knots at about 100 feet altitude. This is when the accident occurred — $500,000 worth of aircraft destroyed and ten bruised and frightened people.

After the accident I started to ask myself questions. Why were we at 10 knots and 100 feet? Why didn't we make a go-around? Or better yet, why didn't we see that CH-47 before he cut in front of us? If we had made a go-around we would have been at a higher air speed. Then if the tail rotor had failed, a more successful landing might have been accomplished. In addition, at a higher air speed less stress would have been applied to the tail rotor and conceivably it may not have failed until we were near or on the landing pad. In addition, if we had been paying closer attention we might have seen the CH-47 much sooner and adjusted accordingly.

I learned something from this accident, and I hope that anyone who reads this story will, also. What I learned is that people cause accidents mainly through unsafe acts. The mechanic was unsafe in the procedure he used in the assembly of the tail rotor. The mechanic's supervisor was unsafe in that he didn't properly inspect the mechanic's work. We were unsafe because we didn't use proper procedure in avoiding the CH-47.

Accidents can be prevented. How? Easy! Make safety *your* business. The next time you see a mechanic or a pilot doing something improperly just go up to him and say, "Hey, that ain't right!"

"Worth Remembering"

THE OTHER DAY while I was waiting for the morning briefing one of my students asked if I had a type of preflight checklist that he could use. He said that while he was in this course of instruction he would not have any problem remembering all the items to check that are necessary to complete a good safe instrument flight, but after he left here and returned to his home unit he would need some type of checklist. The type of flying that he does may only require instrument flight once or twice a month, and sometimes he may go 2 or 3 months without flying at all. What he wanted was a checklist that he could pull out and use when he had been away from instrument flying for some time.

What I propose to do with the following is show you the system that I use when I have a mission that I can fly using instrument flight rules (IFR). I will briefly outline the checklist and then discuss each item in detail.

I. Copilot briefing.
II. Mission and destination.
III. Weather-terminal area forecast.
IV. Publications
  a. IFR Supplement.
  b. Low Altitude Instrument Approach Procedures.
  c. Regulations.
  d. Enroute Low Altitude Chart.
V. NOTAMs
VI. Weather-winds aloft forecast.
VII. Flight Log-DA 2283.
VIII. Flight Plan-DD 175.
IX. Weather-DD 175-1 briefing.

I. Planning, whenever possible, should be a team effort (two heads are better) so the acquisition and briefing of the copilot ought to be the pilot's first checklist item. Both then will take part in the planning and briefings. Remember that under current regulations the copilot doesn't have to be qualified in the aircraft being flown, therefore, some modification of the copilot checklist and duties may be needed.

Be sure that your copilot understands what will be going on during the flight and that you know his qualifications. The accompanying figure (opposite page) is the copilot briefing guide that is used in the Instrument Methods of Instruction Course at the U. S. Army Aviation School, Ft. Rucker, AL. Use it or one like it.

II. You must consider the mission and destination. The mission requirements may deem it necessary to operate in VFR conditions or place some restrictions on you that would preclude flying under instrument flight rules. AR 95-1 specifies that, except for certain types of aircraft, all flights will be conducted on an IFR flight plan when the aircraft is instrumented for IFR flight and an instrument rated aviator is in command, except under certain conditions. AR 95-1, page 4-3, paragraph 4-10b, specifies the times when an IFR flight plan is not required.

Once you have determined that the mission requirements will not restrict you from flying IFR, take a quick look at your destination. You will be researching it more as you go. Right now all you want to do is get a general idea of what to expect or what to look for. How far away is your destination? Are you going to have to make a refueling stop? Is your final destination at a major airport or at a small field? Does it have an instrument approach? What type facilities does it have? These are a few of the questions that you need to be thinking about from the begin-

ning. The answers to these questions will be found in the publications discussed below.

III. The next step in your preflight is to check with the local weather forecaster to get a general idea of what the weather is going to be like from departure to destination. It is not going to do any good to plan a flight if the weather is too poor to take off or to land at your destination. A call to the local weather forecaster will provide you with the necessary information. If you are unable to contact him or your location does not have a forecaster, either call long distance to a U. S. Air Force or U. S. Navy weather facility, or the nearest Federal Aviation Administration (FAA) flight service station (FSS). In the back of the IFR Supplement is a listing of telephone numbers, both AUTOVON and commercial, that can be used to get a complete DD 175-1 weather briefing. At many civilian fields where there is not an FSS, there will be a direct line or a similar arrangement you can use to contact an FSS. Keep in mind that what you want to do now is get just a general idea of the weather situation. The complete briefing comes later.

IV. After determining that the weather is going to be good enough to go, it is time to sit down with the necessary publications to begin outlining your flight. The first publication that I consult is the IFR Supplement which contains a wealth of information not found in other publications. In it is found specific data about field elevation, lighting, runway length and composition, fuel and oil availability, special information about the aerodrome, local communication frequencies, radio aids to navigation and radar minima. All of this information is found listed under the aerodrome name and by referring to the legend pages the data is readily understandable. It is very important to read and understand all the information given. Think how embarrassing and costly it would be to arrive at an airfield where you planned on having military base supply fuel, only to find that all that is available is no-contract commercial fuel. It is equally important to pay close attention to the section on aerodromes remarks. This section contains information essential for operational use of the airfield. An example would be the period of time that the airfield is attended when not open around the clock. Page 8 of the IFR Supplement shows a listing of the type of information that may be included in the re-

INSTRUMENT FLIGHT
COPILOT BRIEFING

INTRODUCTION

1. Determine Copilot Qualifications
2. Uniform and Equipment
3. Type and ID of Aircraft and Equipment

COPILOTS DUTIES

1. Fly Headings/Track, Airspeed, and Altitude as assigned.
2. Tune and ID commo and nav radios as requested.
3. Perform Take-off, Level-off and Landing checks on request.
4. Record power settings, fuel and times as requested.
5. Copy all clearances, headings, altitudes, frequencies and other information received from controllers when pilot is at controls
6. Monitor aircraft instruments and caution lights.
7. Compute fuel and compare with pilots.
8. On breakout and field in sight, Land A/C on appropriate runway.
9. Be prepared to execute a missed approach.

OPERATIONAL PROCEDURES

1. Transfer of aircraft control
2. Alert for reported aircraft and VFR conditions
3. Mission:
4. Route of flight, approaches and alternate if required.
5. Weather: Take-off, Enroute, Destination, and Alternate.
6. Approach Briefing:
   a. ID of Approach b. MDA or DH c. Time from fix to field
   d. Verify missed approach procedures.
7. Emergency Procedures: Engine, Electrical, and Hydraulic.
   Assist with switches and circuit breakers as required.

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marks section and also a listing of information not included.

The specific data to look for is:

- Type of fuel and oil service available.
- Are there restrictions to the transient service?
- Is the airfield going to be attended?
- Are there any items that would put a restriction on you? If so, how will they affect the flight?
- The communications facilities and their frequencies that will be available.
- The frequencies and geographical locations of radio aids to navigation that are available.
- Whether any of the facilities have radar capabilities.

From the IFR Supplement move to the Low Altitude Instrument Approach Procedures book. In going over this publication first find the pages concerned with your destination. It is sometimes easier and quicker to look up the airport name in the table of contents and find which page it is on rather than just thumbing through the pages.

The table of contents will list a page for each type of instrument approach available. When looking at these approach plates look at all that are available for the airfield and especially those that you and your aircraft are capable of executing. Always plan for the approach that will give the lowest minima, normally an instrument landing system or precision approach radar. This approach will be of primary concern but also have a good idea of what other approaches are available in the event you are unable to initiate or complete the primary. Things to look for are:

- The required weather minima for the approach.
- The lowest minimum descent altitude (MDA) or decision height (DH).

Note: The type checklist prescribed by the author is used at USAAVNS to familiarize a student with procedures. When DD Form 175 and DD Form 175-1 are filled out according to AR 95-1 and FLIP Section II, additional checklists are not required. The DD Form 175 and 175-1 provide the basic guidance an aviator needs when filing an IFR flight plan. If filing from a civilian airfield, the appropriate civilian flight plan may be used as a checklist.—Editor

- The note or remarks section for special information.
- The initial and final approach fixes.
- Feeder fixes and enroute fixes.
- Minimum safe altitudes.
- Communications frequencies.

Once you have this information look at the other approach plates and note the types of approaches available, weather minima for their MDA or DH. Again, if you are in doubt about the meaning of any of the symbols go over the legend in the front of the book.

Don't forget to review standard instrument departures (SIDs), standard terminal arrival routes (STARs) and terminal control area (TCA) charts for departure, destination and alternate airfields if appropriate. Make a point to study any nonstandard alternate and authorized/unauthorized flight procedures.

The next publication that I feel is worthy of discussion is Army regulation 95-1. This is important because it gives you the requirements and restrictions for instrument flying. I mention this regulation because a knowledge of weather requirements is important and AR 95-1 is the book to look at. After determining the approach to plan for, you need to start comparing the required weather minima with the forecast weather that you obtained earlier. At this point you are going to determine whether or not the forecast is sufficient to file, and, if so, do you need an alternate airfield? If you do then you need to go through this checklist again with the alternate, keeping in mind that the alternate weather requirements are not the same as those for your destination.

Now you are ready to determine how to get to your destination. You will have to go over an enroute low altitude (ELA) chart. Check preferred routes in DOD FLIP Section II. On the ELA chart look for the shortest route, using airways whenever possible. On the airways check for the minimum enroute altitude (MEA); if off-airway routes or route segments check minimum obstruction clearance altitude (MOCA), distances between facilities and navaid reception ranges. Determine the altitude to fly—one which will guarantee obstacle clearance and radio reception along the route. If at all possible use established airways, but if it is necessary to use direct routes then determine your own MEA and ensure the distance traveled on this route is within the specified reception ranges of the navaids used.

On the airways determine if there will be compulsory reporting points and plan accordingly. Note at what points the flight changes from one airway to another or the point at which the airway changes directions. Also note the intersections along the route to see if there is a minimum reception altitude (MRA) or minimum crossing altitude

(MCA) that applies. Additionally, it would be wise to reexamine lost communications procedures while on the ground and enroute.

When you have the route mentally planned, fill out the flight log, DA Form 2283. But first, check two other things: NOTAMs and what winds aloft are forecast at your planned altitude.

V. Check NOTAMs to see if there is any information of a temporary nature that will affect your flight. For NOTAMs check with your local operations or call the nearest FSS.

VI. Get the winds aloft forecast and temperature at altitude for the flight route. These are needed to figure ground speeds and true air speed.

VII. The DA Form 2283, Army Aviation Flight Log, is an important part of the instrument preflight. This form is going to be an information log and a record of your planned route. Completed, it is going to tell you where you are going, how you are going to get there, how long it is going to take, how fast you are going, how much fuel you need and how far you have to go before you get there. Everyone should use the flight log or a similar system.

One point I would like to stress is the need to identify each intersection along the planned route. There are two reasons for wanting to do this. First, it gives a more accurate estimate of your position at all times, and second, it tells if your estimates and ground speeds are correct. After completing the flight log you are ready to move on to the flight plan.

VIII. When everything is planned transfer it to the flight plan. Whether you are using a DD Form 175 or FAA 7322-1 make sure that all of the necessary information is on the flight plan. It is a good idea to have a FLIP Section II available when filling out the flight plan. There are enough procedures that are changing or may have been changed to warrant going by the book.

IX. The final step in the instrument preflight is to get a complete weather briefing on a DD Form 175-1 that will be filed with your flight plan. This briefing will verify what you have obtained before. If there are any changes determine how they will affect your flight and make necessary adjustments. This briefing should contain departure weather, enroute conditions and terminal area forecasts for the destination and alternate, if required.

This completes my checklist and I hope it may do you some good. It is by no means exact or permanent. I have found it works for me and I believe it will for you.

INSTRUMENT COMMENT

Q. Why do some airways designate an MOCA (minimum obstruction clearance altitude) and others do not? Also, am I authorized IFR flight at the MOCA?

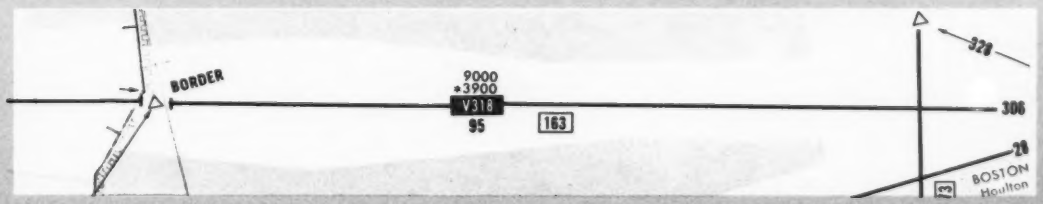
A. (U. S. Procedure) An MOCA is shown on enroute charts directly below the MEA (minimum enroute altitude) and is identified by an asterisk.

The designation of an MOCA indicates that a higher MEA has been established for that particular airway or segment because of signal reception requirements. When no MOCA is shown on the chart the MEA and MOCA are considered to be the same.

An aircraft may be cleared below the MEA but not below the MOCA provided the altitude assigned is at least 500 feet above the floor of controlled airspace along a designated airway, and . . .

. . . Nonradar environment — aircraft is within 22 nautical miles of an NDB, a VOR, VORTAC or TACAN;

. . . Radar environment — aircraft is being radar vectored and has been issued lost communications instructions.



The author relates from personal experience some helicopter flight techniques employed by his Australian Army aviation unit while in New Guinea. The story reveals those procedures which were used by the unit when necessary to accomplish the mission. The techniques described are in accord with the Pilot's Handbook—the Australian version of the dash 10, however, they vary with U. S. Army aviation doctrine. The article is intended to stimulate thought about pilot techniques and capabilities of the helicopter at altitude

Fickle Winds And High Altitude Operations

Major James D. Campbell
Australian Army Exchange Officer

ON ARRIVAL near the mountaintop at 14,700 feet (density altitude 17,000) a power check was carried out and the gauge indicated that the OH-13 helicopter engine was producing the manufacturer's rated power as per the performance data in the manuals. The performance data we checked before takeoff indicated that the helicopter would hover in ground effect (IGE) at a slightly higher gross weight than we were at—but would not hover out of ground effect (OGE). A light wind was blowing but due to the rocky terrain with sheer drops and mist buildup it was difficult to determine the best approach direction to the only flat area of rock available for landing.

The first approach was aborted as the ground speed appeared excessive in relation to the indicated air speed in the final stages [30 knots calibrated air speed (CAS) gave 39 knots true air speed (TAS) at that density altitude]. The second approach—at a shallow angle to give minimum rate of descent and also down the side of the mountain to allow the descent to continue in case of an abort—appeared smooth and normal until the aircraft passed below effective translational lift. Then it dropped like a streamlined brick . . . luckily onto the edge of the usable area and slid to a halt without damage.

After overcoming the initial shock of finding out that passing below effective translational lift speed and overpitching was like having an engine failure at the hover, I found that although the charts in the manuals indicated that the aircraft should have hovered at 2 feet easily it would barely become light on the skids at full throttle. This discrepancy in performance plus the fact that I was landing with a slight tail wind almost made us a new terrain feature in the area.

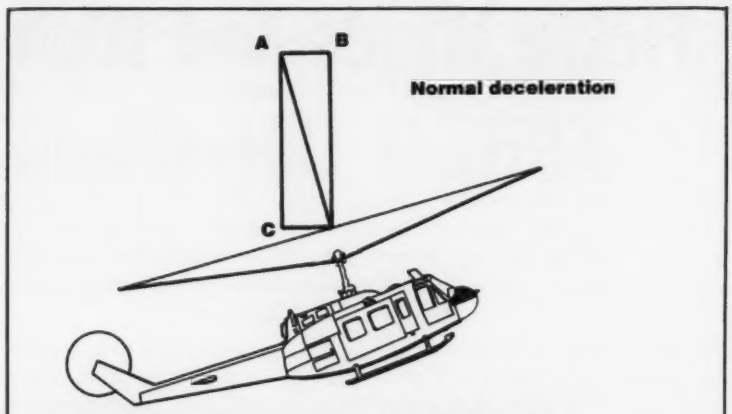
* * *

As this incident shows there are problems operating at altitude when the winds are light and variable or appear calm and the aircraft is at or near gross weight for hovering IGE for the density altitude (DA) which exists at that time. Some are discussed below.

Approaches: Clear conditions and light winds in the mountains are present when a lot of overpitching accidents or incidents occur. This, I feel, in a lot of cases is due to the pilot not assessing the wind direction correctly or experiencing a variation in wind direction at the critical moment around effective translational lift speed on takeoff or landing.

The problem of assessing wind speed by relating ground speed to indicated air speed (IAS) is made difficult to the new operator by the fact that the difference between IAS and TAS will be much greater at altitude. For example, in a UH-1H (nose mounted pitot) on a standard day at sea level with nil wind IAS 60 knots (CAS 69.5 knots) ground speed will be 69.5 knots. At 12,000 feet with a DA of 15,000 feet under nil wind conditions the same IAS (same CAS) will give a ground speed of 87 knots. If a pilot made a pass over the 12,000-foot pad in one direction he could believe he had a tail wind and, since he had no drift, land in the opposite direction. This is good if a nil wind condition existed, but if on his original pass he was heading into a 10-knot headwind his ground speed would still have been higher than he was used to seeing at sea level and he

NOTE: Overpitching occurs when the engine is producing maximum power and the torque available is insufficient to turn the rotor at normal operating rpm, consequently rotor rpm decreases. This is because excessive pitch has been applied for the power available from the engine at high altitudes. In addition to the reduction in lift there is a reduction in controllability and cyclic, antitorque control becomes marginal, and the helicopter begins settling with power



A. Resultant lift acting at right angles to tip path plane
B. Vertical component of lift
C. Horizontal component of lift (this provides the decelerating force)

Figure 1

could believe he had a tail wind and attempt a downwind landing. If he had a gross weight which only allowed him to hover IGE and did not abort the approach he would pass below effective translational lift short of the touchdown area, overpitch and land heavily on whatever happened to be below him, unless he had sufficient height to lower the nose and collective to pick up air speed and rotor rpm (this could be a couple of hundred feet depending on the rotor rpm decay and aircraft attitude).

The type of approach also is critical under the conditions discussed above. If we commenced a normal or steep approach to the 12,000-foot pad with a DA of 15,000 feet and nil wind conditions in a UH-1H with a nose mounted pitot tube, at 60 knots IAS we actually are starting the approach 18 knots faster than the same approach at sea level with 60 knots IAS on a standard day. Again the figures out of the UH-1H dash 10 manual for a nose mounted pitot tube are:

	0 ft DA	*15,000 ft DA*
IAS	60 knots	60 knots
CAS	69.5 knots	69.5 knots
TAS	69.5 knots	87.5 knots

Although IAS and CAS vary between aircraft models and aircraft attitude and has to be obtained out of the respective manuals, the difference between CAS and TAS can be obtained from the computer and holds true for all aircraft.

How is this higher TAS going to affect an approach? It will require a greater deceleration to bring the helicopter back to zero speed for touchdown at altitude than at sea level. At the point in the approach when maximum decelerating attitude is reached (about 30 feet to 50 feet above ground level) and the pilot starts easing forward cyclic and bringing in power, it is going to take more power to keep the rate of closure constant with the greater deceleration. It requires more pitch in the blades at altitude just to provide the lift to support the weight of the aircraft without having to provide the additional lift. This is because the tip path plane is tilted farther to the rear and the vertical component of lift (which governs rate of descent) is less (figures 1 and 2).

This additional power may not be available and it usually results in overpitching and one of the following:

- Arriving on the pad with the seat a little lower in the aircraft and skids level with the floor.
- Becoming a new terrain feature short of the pad.
- An abort—if you are very lucky and recognized the problem soon enough to allow sufficient altitude for recovery.

So how should the approach be made under these conditions? The best approach is a long very shallow one to the ground on the forward (upwind) edge of the usable area. This shallow approach gives a minimum rate of descent so that valuable power is not wasted in slowing down vertical momentum. It also means very little change in the fuselage attitude and plane of the rotor disc so excessive increases in power are not required from the engine in the final stages of the approach.

I advocate the shallow approach only when nil wind or light variable winds are blowing. I would increase the angle of approach with the strength of the wind to keep out of turbulence, however, I also would decrease my IAS on entry with the steeper approaches and keep the rate of descent very slow during the final stages of the approach. For pinnacles and ridgeline landings never approach straight in or at right angles to the terrain but rather come at an angle to allow an escape route to a lower altitude—in case of an aborted approach.

In most mountainous areas—especially in some of the underdeveloped areas of the world—people don't like to spend too much time making good, big, level helipads and they rarely come ready-made. Usually the pilot operating at altitude is landing in areas where hovering IGE is not possible or is partially possible. For the first landing in a new area the pilot should plan his load so that the helicopter can be hovered OGE

with some reserve power.

In high altitude operations anything can happen and usually does at just the time when it is least convenient. And while no handbook has been written to cover all of the problems one can encounter, the following can be used as a guide.

Before takeoff from the base area:

• Using the predicted temperature at the intended landing point and pressure altitude, work out the maximum all uplanding weight you can have to hover OGE (for first landing) or hover IGE. Also work out the maximum torque or manifold pressure you will get.

• Make sure the aircraft is loaded to minimum possible weight to complete the mission but always include a survival kit.

On arrival in the area of intended landing:

• Pull full power until overpitching occurs or redline EGT is reached (whichever comes first) and note the torque setting or manifold pressure. A check is then made at 40 knots straight and level. The difference in power can give the pilot a good idea whether he can hover in or out of ground effect and what power he has in reserve for the landing. A check can also be made against the data sheet which was made up before takeoff, however, if the maximum torque or manifold pressure obtained does not agree with the predicted figure the hovering IGE and OGE figures are going to be incorrect.

• If it is to be a landing where sufficient power to hover OGE is required and a further check is needed, keeping a safe altitude (at least 500 feet above ground level) bring the helicopter back to a hover and check that there is sufficient power to maintain altitude.

• Very carefully assess the wind direction.

• Do a shallow approach and, maintaining about 40 knots, overfly the intended touchdown point as low as is safely possible to check for slope, size, shape and firmness of the intended touchdown point.

• Carry out the shallow approach all the way to the ground.

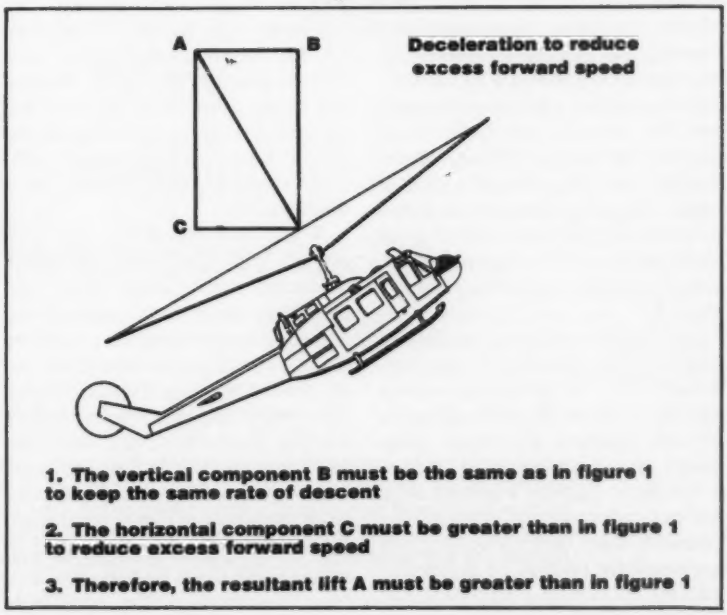
• If at any stage during the approach you feel that everything is not going smoothly as planned, abort the approach as early as possible. Do not try to salvage a poor approach at altitude. If, after a number of aborted approaches, it is apparent that some doubt exists about the chances of a safe landing being accomplished—due to downdraughts or for some other reason—go home before you have to use your survival kit and return when conditions improve . . . or you have reduced your gross weight.

Takeoffs: Whilst most pilots operating at sea level would consider a takeoff a cinch if confronted with a quarter mile or so of gently sloping marshy land or rock-studded ground falling away in front of them, it could be an invitation to overload and disaster at altitude.

Some time ago I was nearby when a similar set of conditions existed. We were to ferry a survey party from an 11,500-foot mountain peak to a strip where a fixed wing aircraft was to pick them up. Due to cloud buildup on one side of the range, it was decided to initially ferry the party to a clearing on a nearby saddle at 8,500 feet (DA about 11,000 feet) in case the light wind blowing changed and the peak was clouded in.

The party was successfully moved to the saddle and then the mission of ferrying them to the airstrip commenced. The wind initially on the saddle was a steady 5 knots from the east, and before each takeoff we would check the wind direction by moving well away from the aircraft and throwing a handfull of grass in the air. Because of a wind shift I changed my takeoff direction for the second to last lift and waited at the airstrip for the other aircraft to return with the last lift. After 25 minutes on the ground I became alarmed at his nonappearance and took off to

Figure 2



1. The vertical component B must be the same as in figure 1 to keep the same rate of descent

2. The horizontal component C must be greater than in figure 1 to reduce excess forward speed

3. Therefore, the resultant lift A must be greater than in figure 1

follow the route back to the pickup point.

The other aircraft was lying with the skid and cross tubes torn from one side on relatively clear ground about 200 meters from the takeoff point. Mist and clouds were starting to obscure the saddle and the wind was coming from the west. The pilot had checked the wind before takeoff and it was coming from the east (about 100 degrees from the direction at my last check), so he took off into the east.

Because of the loads we were lifting, we could just get a 3-foot hover at full throttle and anything over this caused overpitching. Our takeoffs were made with minimum ground clearance and a very gradual acceleration. After passing through translational lift, a reduction of power normally was made to give a reserve of power if needed and also to leave the aircraft at an altitude where it was in ground effect if the wind gusts dropped the TAS back below effective translational lift before the aircraft could accelerate to a reasonable climb speed. In this case the pilot took off to the east, picked up a gust which put him above effective translational lift and caused the helicopter to climb 15 to 20 feet, then the wind dropped momentarily and the aircraft was back below effective translational lift speed and started sinking toward mother earth. The pilot already was at full throttle, and when he pulled pitch to stop the sink overpitching occurred and the aircraft struck the ground.

On another occasion a civilian pilot working in our area was confronted with deteriorating weather and the problem of overloading the aircraft (against his better judgment) or leaving one man to spend a wet bleak night on a mountaintop without adequate protection. As he had a slight downslope run over low shrub for takeoff, he decided to load the extra man. The result? The *whole* party . . . plus a bent aircraft . . . spent a wet miserable night high in the mountains without adequate protection.

The takeoff at altitude from a pinnacle, ridgeline or shelf on a mountainside offers the least problems. If operating at high gross weight the helicopter is moved to a position at the forward edge of the usable area and takeoff is made from the ground with rpm being traded off to clear the edge (if operating at full throttle and overpitching occurs). Then the collective is lowered and the helicopter is put into a dive only sufficiently to regain normal operating rpm. Extreme care must be exercised to ensure that engine and rotor limitations are not exceeded. Abrupt power changes must be avoided in all maneuvers at altitude because —apart from the greater chances of an engine failure occurring— rpm control is very sensitive.

The takeoff from a position which has obstacles either slightly below, level with or higher than the takeoff point requires a thorough ground reconnaissance and varying degrees of planning. The helicopter can be backed up into the far corner of the usable area and an abort point may be worked out where, if effective translational lift has not been reached and the takeoff must be discontinued, sufficient clear ground remains for a deceleration.

Where the takeoff is to be made out of a gully or ravine and higher obstacles exist behind those immediately ahead of the takeoff run, a ground reconnaissance should be made to confirm the best route out so that turns can be anticipated (the high reconnaissance before landing should have just about determined the takeoff run with some degree of certainty). In this type of situation where a climb, level flight or a slight descent is required to clear obstacles on takeoff, the takeoff should be aborted if overpitching or rotor rpm bleed off occurs at full throttle before reaching effective translational lift. If full throttle would only maintain normal operating rpm up to the point of passing through effective translational lift, decrease power slightly immediately after passing that point (since the system becomes more efficient) to keep some reserve power in case of a wind shift or if sink occurs before a safe climb speed can be achieved. If it requires full throttle and rpm right at the point of bleed off or overpitching to barely clear the obstacles on climbout—brother, you made a mistake in planning and Lady Luck happened to have her money on your square in the crap table that day. Don't plan it that way next time because there may be a slight wind shift and the Lady may desert you. Nobody likes to back a loser.

It's a great feeling to wake up in the morning at your base camp at 6,000 feet, look at the fog in the valley below you—the first rays of the sun shining on the 13,000-foot peaks—and prepare to set about the morning's flying before the clouds and tropical thunderstorms obscure the area.

To ensure that you can sit down to dinner that evening without having to pray to the good Lord for helping you to make it through another day, remember:

Care with your planning is well rewarded.

Assure yourself that you know what power is available and power required before commencing the approach and takeoff.

Respect the environment in which you are operating.

Easy on the controls.

Fully prepare yourself to go around if everything doesn't look perfect on the approach.

Use every available aid to determine wind speed and direction.

Leave yourself an escape route on the approach.

TOMORROW'S Rotary Wing Training Requirements

Major Carl A. Weaver Jr.
Combat and Training Developments
U. S. Army Aviation School, Ft. Rucker, Al

The author theorizes future aircrew training via a discussion of man/machine relationships with respect to the future operational environment. He describes basic rotary wing systems and subsystems of the future and projected human factors problems are examined as they pertain to the operational environment. Future rotary wing crewmember training requirements are identified in relation to future systems and future operational requirements. The author poses questions with behavioral science research implications and establishes priorities

MODERN SYSTEMS are no more than extensions of man's sensory, muscular and intellectual capabilities. It is extremely important, therefore, to design systems for optimum man/machine interface. Attention to the interfaces between man and machine is of particular importance in the design of military systems because such systems are operated in very hazardous environments. The nature of combat operations demands that system effectiveness be maximized.

System design goals for Army aircraft generally can be categorized as follows: to acquire targets, to destroy targets and to deliver troops and supplies. In order to identify future aircrew training requirements, the following questions must be answered:

- What are the design trends which pertain to future rotary wing systems and subsystems?
- What are the important man/machine interfaces pertaining to future rotary wing systems?
- What is the impact of design trends and man/machine interfaces on the Army's future rotary wing aircrew training requirements?

This article first presents an overview of the man/machine problems of the future with respect to rotary wing system trends and the operational environment in

which the crewmen will function. Second, it presents and identifies future training requirements which are not part of today's programs. Third, it poses a series of behavioral research oriented questions which may need to be answered before future training methodology can be determined or established.

To establish a definite timeframe for this article would be unrealistic. The approach, therefore, is to realistically identify future operational and equipment trends while still associating them with aircraft systems and subsystems within our grasp. The *future* is defined here as that period of time when the Army can expect to have a new generation of aircraft systems capable of operating and surviving in a high threat area.

It is impossible to consider future training requirements in isolation. Training is complex and the interactions between behavioral science materiel development and the operational environment is complicated. A total system approach to include the machine, the man and the environment must be used to construct a framework. In order to preserve some degree of simplicity, several limitations have been imposed. First, this article is limited to Army rotary wing systems and subsystems of the future. Second, despite many important human factor considerations which have some bearing, the topic is confined to those man/machine factors important only to future rotary wing training requirements. Finally, this article does not examine systems or training requirements expected or predicted to remain the same.

Rotary wing training is unique because helicopter tactics, strategy or missions essentially have no heritage through other aircraft. Likewise, the helicopter shares so few performance characteristics with fixed wing systems that it is influenced by the environment quite differently from other aircraft. Because of this lack of heritage and because of the complex interaction between helicopter utilization and all branches of the Army, it is expected that future rotary wing training requirements will have an impact on the Army at all levels, as programs are developed from scratch.

Future training requirements will directly affect both the primary aviation training school or any one of the branch/center schools having proponency for a particular aircraft system. Of course, the degree of impact will vary as current training philosophy and methodology are altered with respect to future requirements.

The Machine: Rotary wing machines of the future can be predicted easily. First, consider the functions of land combat and the role that Army aviation must play supporting these functions. Army aviation functions are aerial surveillance, reconnaissance, attack, troop movement and logistical support. It can generally be assumed that aerial surveillance functions, such as photography, infrared detection, side looking airborne radar radio research and the like, will remain a fixed mission for some time in the future. This is due to the nature of sensor systems and the profile of electronic surveillance missions. The manned aerial vehicle for surveillance and its drone counterpart are therefore not addressed. Similarly, future fixed wing utility or multipurpose aircraft are not examined. We can assume the future airframes needed to support the remaining functions are entirely rotary wing.

The first type of future helicopter envisioned is the scout which is to be used primarily to acquire targets for ground and aerial firepower as well as to perform reconnaissance and surveillance missions. Second, an important partner to the scout is the attack helicopter. With its various missions such as antitank or aerial artillery, the attack helicopter is to be employed as a member of a scout/attack helicopter team. The third airframe is the utility helicopter. Its roles and missions as a troop carrier, forward area resupply and medical evacuation will remain generally the same as they are today. A fourth system is the medium lift helicopter. This ma-

Figure 1. Rotary wing aircraft system development trend

Type	Past	Present	Future	
			Lo	Hi
Observation (Scout)	OH-13 OH-23 (0-1)*	OH-6 OH-58	Improved OH-58	Advanced Scout Helicopter (ASH)
Attack	UH-1B	AH-1G AH-1Q	Improved AH-1	Advanced Attack Helicopter (AAH)
Utility	UH-19 CH-21 CH-34 (U-6)* (U-1)*	UH-1D UH-1H	Improved UH-1	Utility Tactical Transport Aircraft System (UTTAS)
Medium Lift 10 to 12 Tons	CH-37	CH-47 CH-54	Improved CH-47	Light Tactical Transport Aircraft System (LTTAS)
Heavy Lift 20+ Tons	No Predecessor		None	Heavy Lift Helicopter (HLH)

*Obsolete fixed wing aircraft

chine will provide logistical support with a 10 to 12 ton capability. The fifth system is a new entry into the aviation arena—the heavy lift helicopter. This system, for which there is no current counterpart, will provide the Army with a logistical support capability in excess of 20 tons and a gap crossing capability limited only by the number of aircraft and their availability.

Rotary Wing System Trends: The general trend of rotary wing system development has several interesting characteristics. The major trend is to limit the basic types of aircraft systems and reduce the number of versions of each basic airframe to a minimum. In the past fixed wing Army aircraft which had mission overlap with existing rotary wing systems have been eliminated from the inventory. As seen in figure 1, the present trend is toward establishing one basic airframe for each of the five basic rotary wing types described above.

Despite this major trend, it is not logical that sufficient numbers of future systems will appear simultaneously. The high anticipated cost of new systems, variations in lead times and a peacetime rate of obsolescence dictates a more reasonable solution. As the chart depicts, a "Hi/Lo" mix is envisioned. Each advanced system (Hi cost) will be supplemented by current systems (relative Lo cost). Improved versions of current systems are projected into the future to ensure mission continuity during the long lead times associated with the development and acquisition of complex systems.

Follow-on or replacement aircraft systems trend toward increased complexity. Advancing technology continuously offers innovations which along with stringent requirements generated by mission demands are causing cockpits to become increasingly complex. There are three undesirable characteristics of the growing complexity. First, the limits of the airframe soon are exceeded; second, it isn't long before the pilot's capabilities are impaired; and third, new training requirements are generated.

Man/machine interface and human factor considerations will become much more important. To optimize system performance, human factors have to be considered from the beginning during system and subsystem integration. When a system is "hung on" the basis for efficient information flow between the machine and the man is degraded with respect to the total system. Even though the demand for greater system effectiveness continues to increase, system development and system change decisions are often made without information about the human component's contribution to system effectiveness.

The requirement to meet the increased demands of the future battlefield is the most important consideration in the proliferation of gadgets in the cockpit. Figure 2 shows a partial listing of some systems and subsystems that have been added or will be added in rotary wing cockpits. By no means is this list intended to be complete, but these items are significant because each has a definite impact on future training requirements. It is important to remember that with each new subsystem introduction the pilot must learn new tasks and performance methods.

In addition to those associated with hardware, there are trends toward improved helicopter performance. New performance capabilities are developed primarily to cope with the demands of mission requirements. Speed, lateral agility and hover are three performance trends of great importance to future training (figure 3).

Concerning speed, it is a fact that helicopters are faster than several years ago, but this will have little impact on future training. Early helicopters hovered in ground effect and accelerated to a cruising speed within a band limited by a lack of capability to hover out of ground effect, or to conduct a safe autorotation. Because of advancements in performance technology, the helicopter of today and the future will be operated with a greater speed envelope and relatively fewer performance restrictions on altitudes and operating speeds.

The second performance consideration is that of lateral agility. This is a new characteristic that is separate and distinct from side-

Figure 2. Examples of the proliferation of cockpit complexity in Army rotary wing aircraft

- Aircraft survivability equipment (ASE)
  - Aircraft electronic warfare self-protection systems
  - Vulnerability reduction systems
- Advanced navigation systems
- Night vision systems
- Sophisticated load acquisition devices
- Target acquisition systems
- Sophisticated weapons systems
- Multiengine configurations
- Miscellaneous mission aids
  - Collision warning system
  - Fixed format message entry device

Figure 3. Examples of the trend toward improved rotary wing performance characteristics of Army helicopters

	Past	Future
Speed	Less than 100 knots Restricted speed selection	Approaching 200 knots Unrestricted speed selection
Agility	Limited to forward accelerations	Rapid and frequent multidirectional accelerations and decelerations
Hover	In ground effect	Out of ground effect at mission gross weight

ward flight which has always been a capability of the helicopter. Certain future helicopter designs will specifically incorporate the capability to accelerate rapidly in any direction. This technique has been of little concern to past helicopter pilots, but it will have to be considered in future training programs.

Hover is the third important performance consideration resulting from technology advancement. Two distinct aspects of hover operations are applicable to future training considerations. The first is hovering out of ground effect and the hover relationship to spatial orientation. During periods of reduced visibility the pilot may have to operate his machine out of ground effect without real world references for orientation. For example, consider the attack helicopter pilot hovering out of ground effect at night to engage a target.

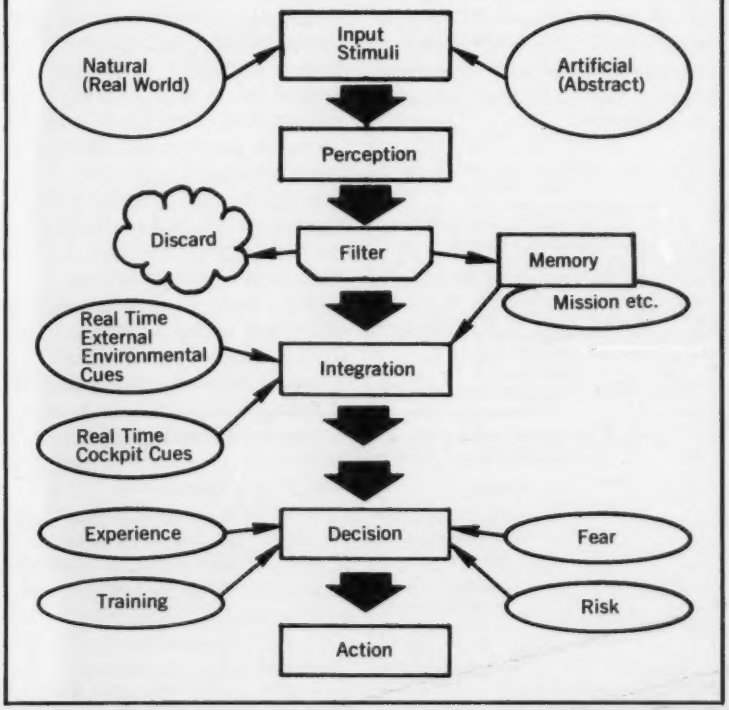
Another significant aspect of hover operations is precision. The requirement for precise hover is dictated by the operational environment. Operating attack and scout helicopters close to terrain and vegetation during periods of darkness or poor visibility introduces a problem that has not been significant in the past. Additionally, the need for precision hover can be applied to the heavy lift helicopter for load acquisition. High operating costs and high fuel consumption make imperative the capability to minimize hover time through the use of precision hover techniques. Reduced hover time can reduce the operating costs and maintenance downtime of the few high cost, complex, heavy lift systems the Army will have in the inventory.

The Environment, New Operational Considerations: Along with trends associated with equipment, the operational environment which tomorrow's helicopter pilot faces also has an impact on training requirements. The advancement of foreign technology is creating a threat to Army aviation's survival on the battlefield. This requires that tactics be changed and new techniques developed. The threat is significant and it would be inappropriate to assume that countermeasures can be developed for each element of the threat.

Countering a threat is a difficult task. It is necessary to learn to live with the problem and adjust accordingly. One such adjustment involves a new technique to enhance helicopter survival on the battlefield. With sophisticated enemy air defense systems which can umbrella the battle area—to include intrusion into friendly airspace—Army aviation is forced to operate within the protective confines of terrain and vegetation. The trend is to operate nap-of-the-earth, under the threat, thereby reducing exposure. Despite the fact that the enemy is faced with the same restrictions we are, a significant threat also exists during periods of night, weather and limited visibility. Army aviators will be expected to operate their complex machines next to the ground, regardless of the weather phenomena, performing flight maneuvers characteristic of a new generation of high performance rotary wing aircraft systems.

The Man: The complex helicopter of the future cannot be placed in perspective with the environment and its future operational considerations without considering man's role. The illustration in figure 4 depicts the process that a helicopter pilot must go through to complete an action following the input of a cue. This article addresses two basic forms of input stimuli. Of course there are more, but for the sake of sim-

Figure 4. Rotary wing pilot decision process



UTTAS is being designed to replace the UH-1 helicopter in the Army's fleet. It will carry an 11 man combat squad

plicity consider only the following.

Natural or real world stimuli are received by the pilot from his surroundings. These inputs include what is presented from outside the cockpit—such as the sight of a tree, a flash or another aircraft. On the other hand, *artificial or abstract stimuli* concern displays which represent the real world symbolically or pictorially.

The methods by which the pilot perceives the input are fixed; they include sight, hearing, feel, taste and smell. Once perceived, the pilot must filter or evaluate the information. Basically, he either discards what is irrelevant, stores what may be useful or processes the information.

If information is selected for processing it must be integrated with other inputs which come from memory and real time cues from the environment outside the aircraft or cues from inside the cockpit. Integration is the point at which the pilot determines his status. Once the information is integrated the pilot makes a decision. He determines what action to take based upon fear, the risk involved, past experience in similar or applicable situations, and training.

What does the trainer have to work with to sharpen the rotary wing aviator's decision process? Natural or real world input is fixed. The materiel developer and trainer have little or no control over real world input to the pilot. System developers can create design to increase the probability that the pilot will perceive these inputs, but design is limited. Similar to natural inputs, cues from the external environment are controlled by someone or something else and considered to be fixed. Fear is a physiological and psychological mechanism. An aviator can learn to live with or control his fear through experience, but man's basic will to survive is the overwhelming factor in this case.

The remaining decision considerations are controllable, alterable or modifiable to varying degrees. For example, artificial inputs are designed by man and can be developed to produce the most effective stimuli possible. This will be true only if the pertinent information can be distinguished from the superfluous and the pilot is given only that minimum input needed to accomplish his task. The filtering process is modifiable. Aviator training can establish or sharpen the filter. The integration process presents a unique problem. The objective of the developer and trainer is to reduce the number of frames of reference for the pilot. It also is necessary to reduce the amount of effort required to go from one frame of reference to another. Hardware must be and is being developed to simplify the integration problem by combining system produced cues, thereby reducing pilot workload. Decision accuracy can be improved through subjecting the crewmember to realistic training and exposing him to experience in both the combat and training environments. The risk facing the pilot in combat can be reduced through experience and training.

A review of the diagram in figure 4 with respect to the points brought out in this article suggests that the following elements in the pilot's thought process will be more important or significant in the future. As artificial inputs become more common, their impact on training will be more distinctive because the presence of such systems increases the pilot's workload. The training problem associated with artificial input is how to teach the crewman to attend to the cues which are important and ignore those that are not pertinent. Filtration will acquire greater significance because it is at this stage that the aviator actually separates the nonpertinent information. Real time external cues and internal cockpit cues will be more valuable primarily because of nap-of-the-earth operations. Integration skill will weigh heavily among future training considerations because of man's basic limitation to the amount of information he is capable of accepting at one time. Likewise, integration will be more influential in the decision process because of the proliferation of complexity within the cockpit.

Understandably, the risk associated with future operations can be expected to be greater because

of the increased chance for error, the awesome threat and the dangers associated with operating near the terrain. Finally, future decisions will be critical because of the momentary nature of the stimuli and the consequences of a wrong decision.

The trainer must seek to influence artificial inputs, the filteration process, the integration process, attention to real time cockpit cues, experience and the risk to develop an acceptable decision process in the rotary wing pilot.

Future Aircrew Training Requirements: Before specific training requirements of the future can be identified, certain basic assumptions must be made:

- That the five basic rotary wing aircraft identified above are representative of what will be available.
- That future systems will continue to increase in complexity.
- That the threat against Army aviation in the operational environment will require operations in proximity to the ground.

There are certain skills Army aviation crewmen must develop before they can operate in a high threat environment. Only the more important skills with human factor implications which can be tied directly to the five basic airframes of the future are addressed here.

The predicted training requirements appearing in figure 5 result from two factors. There are skills that must be developed and taught: (1) because of the introduction of new equipment; and (2) in order to meet operational requirements.

System complexity, as explained, is the proliferation of new subsystems within the aircraft. Even though one of the objectives of advanced technology is to reduce not increase the pilot's workload, the introduction of a new system or subsystem creates a training requirement and an additional burden for the aviator. In addition to these new training requirements the trainer must also contend with the training problems of systems which remain in the inventory. The "Hi/Lo" mix previously mentioned will tend to compound the training requirement in this regard. Seven future training requirements resulting from new equipment are projected. Similarly, nine future training requirements resulting from operational requirements are projected.

Predicted Training Requirements	Heavy Lift	Medium Lift	Utility	Attack	Scout
System Requirements					
Electronic warfare	(X)	(X)	X	X	X
Navigation	X	X	X	X	X
Night vision Equip				X	X
Load acquisition	X	(X)			
Target acquisition				X	X
Weapons training				X	(X)
Multiengine	X	X	X	X	
Operational Requirements					
Speed regime	(X)	(X)	(X)	X	X
Lateral agility				X	X
Hover	X			X	X
Operational orientation	(X)	(X)	X	X	X
Nap-of-the-earth		(X)	(X)	X	X
Communications	X	X	X	X	X
Integrated crew	X	(X)	(X)	X	X
Physiological	X	X	X	X	X
Safety	X	X	X	X	X

(X) Special considerations — X Future training requirements

Figure 5. Summary of selected future training requirements projected for future Army rotary wing aircraft

System Training Requirements

Aircraft Survivability Equipment (ASE) Training. The importance of ASE training is not the need to teach a pilot to turn the system on and off, but the importance of teaching him a whole new set of skills which will enable him to identify the threat and to react properly. A quick analysis of this requirement suggests training on a complete series of evasive actions based upon a thorough understanding of the theory of ASE devices and the threat against which they protect the aviator. One can assume that few medium and heavy lift helicopters will be equipped with ASE devices due to the relative distance from the forward edge of the battle area in which they will be operating. That is not to suggest that there is no ASE training requirement for these two aircraft systems; it is only to point out that other aircraft systems have a greater need for this training by virtue of their missions.

Navigation Training. Navigation training will be more complex because of nap-of-the-earth flight and the introduction of a new generation of navigation devices. For example, training must be conducted on such systems as long range aid to navigation (LORAN) and the national microwave landing system (MLS). Additional training will be required to qualify pilots to operate with the air traffic management and airspace control systems of the future. The most demanding navigation training requirement will be to teach and qualify pilots for nap-of-the-earth flying where they are unable to depend on a navigation system or an aircraft above to guide them.

Night Vision Equipment Training. The introduction of night vision systems requires special training considerations. The very nature of these devices dictates consideration of a man's tolerance for reacting to artificial presentations. Training in the use of night vision systems will be further complicated by the fact that the aviator

must learn to fly with the aid of night vision devices during nap-of-the-earth flight. Because of the high space, weight and dollar penalties associated with night vision systems, they will probably only be employed with a fixed number of future scout and attack helicopters.

Load Acquisition Training. A special load acquisition device is a requirement for the heavy lift system. Because of the extensive lift capability of the machine, high operating costs and the relatively few systems that will be in the inventory, training in load acquisition will be critical. A load acquisition device for the future medium lift helicopter has not yet been identified. It may be similar to the heavy lift device but is expected to be considerably more complicated than lift device associated with the utility helicopter.

Target Acquisition Training. Recent helicopter experience in combat has produced the scout/attack helicopter team concept. Special training considerations currently are required to train pilots for these multiship operations. As future scout and attack helicopters become increasingly complex, numerous additional special training considerations will be necessary. Crews will have to be specially trained in the techniques of artificial (abstract) target acquisition, target designation and target handoff. Due to the nature of the team concept, special training requirements are expected to exist for scout/attack target acquisition peculiar communications.

Weapons Training. The requirement to train attack helicopter pilots in weapons delivery will be more critical for several reasons. First, weapons delivery systems will be expensive and few in number. Second, their lethality necessitates thorough training. Finally, nap-of-the-earth operations with aerial weapons delivery systems will require specialized training. It also will be necessary for the crewmembers of scout helicopters to be thoroughly trained in weapons delivery techniques to achieve maximum scout/attack helicopter team effectiveness.

Multiengine Training. The training implications of multiengine aircraft are well known. It is important to note that except for the scout helicopter, which has not yet been subjected to concept formulation, all of the systems of the future, as depicted in figure 1, are to be multiengine aircraft.

Operational Training Requirements

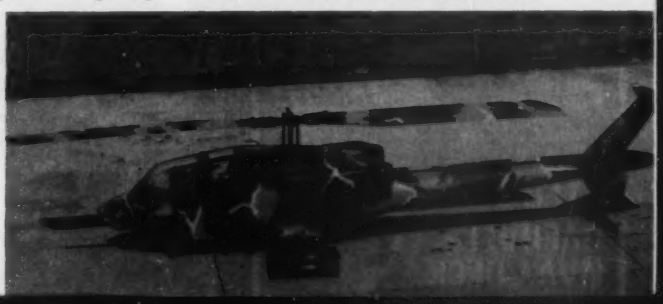
Speed Regime Training. Scout and attack helicopters are the machines most affected by this operational improvement. The aviator who was once taught to take off and maintain a steady speed to his destination now will have to be trained to handle the helicopter under all conditions of speed and altitude to include nap-of-the-earth while in various atmospheric conditions. Speed regime training enhances the performance improvement while reducing previous operational restrictions. It must be kept in mind, however, that there will be severe restrictions on altitude and operating speed selection independent of system performance capabilities, due to the threat.

Lateral Agility Training. Training in lateral agility maneuvers will primarily be conducted for the scout and attack helicopters. Lateral agility maneuvers will be necessary to ensure helicopter survivability on the battlefield during the acquisition and engagement of targets.

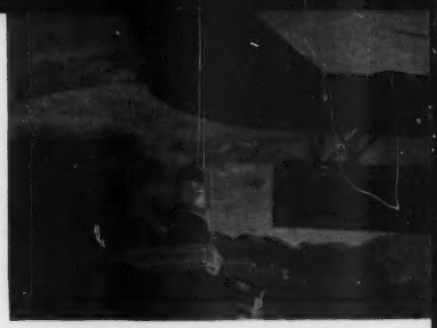
Hover Training. Advanced hover training will be required to qualify pilots for combat operations in the heavy lift, scout and attack helicopters. As stated, this training must include precision hover and spatial orientation operations.

Operational Orientation Training. Operational orientation is the method by which a pilot determines his aircraft's position in relation to other items of an operational concern. For example, the aviator who is operating in a nap-of-the-earth environment will be required to orient his aircraft position with respect to such items as gun target lines, enemy threats, friendly troops and the location of other members of his flight. Pilots designated as leaders of groups or teams of aircraft will have to be trained to manage these teams while flying nap-of-the-earth. Operational orientation is critical even by today's standards and it will be even more critical due to the complexity of the future battlefield. Training of this nature will be less critical with the heavy and the medium lift helicopters because of their limited nap-of-the-earth capabilities, the lesser frequency of multiship operations, and operating distance from the forward edge of the battle area.

Nap-of-the-earth (NOE) Training. Nap-of-the-earth training is one of the most important training requirements of the future. Consideration of the potential threat, techniques needed to survive on the battlefield and the operational environment in which Army aviators will be flying, all stress the need for NOE training. This training will vary by type and intensity among the five airframes identified as future systems. Nap-of-the-earth operations with the heavy lift system will be virtually nonexistent. Normally the heavy lift helicopter can



The advanced attack helicopter will have an anti-armor capability as well as an immediate suppressive fire support for ground forces



HLH ship to shore operations will allow overflying of obstacles with logistical support payloads in excess of 20 tons

be expected to operate sufficiently to the rear to avoid the need of operating close to the ground. On the other hand, situations can be expected to arise which will require the medium lift system to fly NOE for brief periods of time while operating in forward areas. Specialized training is envisioned for all cargo helicopter crews which must become proficient in flying and handling external loads in proximity to the ground. The utility helicopter, on the other hand, will be operating in a nap-of-the-earth environment with greater frequency than the medium lift helicopter due to the requirement to support combat operations in forward areas. Unlike the crewmembers of the medium lift and utility helicopters who must be trained to operate their machines in an NOE environment during periods of acceptable visibility limits, scout and attack helicopter pilots must be trained for NOE operations even during periods of restricted visibility using integral night vision devices.

Communications Training. The basic procedures for communications training of the future is not expected to be much different than it is today. It is reasonable to assume that communications techniques will improve along with communications technology. Future communications training requirements primarily will concern the specialized techniques peculiar to the scout and attack helicopters during target acquisition, designation and handoff. A requirement will exist to train crewmembers to operate non-line-of-sight communications subsystems specially designed for NOE operations. Crews will also require training on automatic communications systems such as TACFIRE, a fixed format message entry device. Finally, there will be a requirement to train all future crews on the specialized techniques necessary for successful communications in a sophisticated electronic warfare environment.

Integrated Crew Training. When the complexity of the machines of the future is considered in relation to the complexity of the tasks of the future battlefield, it is readily apparent that integrated crew functions will be an important training consideration for all aircraft. Integrated crews will be particularly instrumental in the heavy lift, scout and attack systems where mission success is dependent upon the combined actions of crewmembers.

Physiological Training. The physiological demands upon future aircrews must be foreseen when training operators of systems which present artificial cues to the senses, such as a television screen for example. It will be necessary to train these men to accept and tolerate the stresses associated with the operation of such systems in tomorrow's operational environment. There are basically two types of artificial input that must be considered. The first is the symbolic display, such as digital counters on a navigation device, and the second is the pictorial display, such as the TV-like screen associated with thermal image devices. Training requirements for artificial input affect each of the airframes of the future in a different manner. Abstract system training requirements for the heavy lift system involve load acquisition and the associated displays which depict relative aircraft/load position. The necessity for this type of device becomes apparent when considering the problems associated with the acquisition of loads during periods of low visibility or at night and while the machine is hovering near 100 feet above ground level.

Artificial presentations concern the pilots of the medium lift and utility helicopters chiefly as pertains to navigation, since these aircraft lack the complexity of the others. The scout and attack helicopters are the systems affected most by the training requirements generated by abstract or artificial presentations. Artificial displays for these two aircraft are found in the subsystems associated with target acquisition, fire control, navigation and night vision subsystems.

A second aspect of physiological training of particular concern involves all aircraft systems of the future. As established in past conflicts, combat pilots often fly more hours than they should. Pushed by operational requirements, they are driven toward the limits. This phenomena will be compounded in the future by system complexity and NOE operations. Thorough physiological training to include physical conditioning is a necessary future requirement.

Training Safety. With increased emphasis on nap-of-the-earth flight, and the increasing complexity of the machines that Army aviators will be operating in combat, safety becomes more important than ever. Safety is the timeless requirement that must be integrated into future training programs at the outset. Man is and will be the weakest link in aircraft systems. System complexity will inevitably lead to increased crew errors unless safety is fully recognized as a requirement both operationally and in training.

The importance of safety with

regard to future training becomes apparent when it is realized that every training requirement discussed thus far has a safety implication regardless of the system or the mission.

Additional Future Training Considerations

With the machine, the operational environment and the man in mind, it is imperative to think about the behavioral research questions that must be answered in order to meet future aviator training requirements. One of the most compelling questions concerns a vital element for any educational/training system.

What do we teach and how do we teach it? It is apparent that an ability to measure the performance of men who operate complex equipment is needed. Before required performance can be measured, however, the end product and the sequence to meet the complex performance objectives must be defined.

The ultimate training goal is to attain the desired end product with the least expenditure of resources. The additional questions that arise in this regard are:

How do we select and classify students?

How do we select and classify instructors?

Where does the "pipeline" begin for advanced systems training? These questions can be carried a step further. Once trained, the selection of crews for particular types of aircraft and missions is currently left to chance and personal preference. In the future crews must be selected by their demonstrated ability for a particular system.

Will there be a requirement to train a pilot on only one complex system?

How can we determine when a man reaches his limit of stress.

The complexity of future machines and their interface with the crew also raises some very important questions.

How do we cope with training a pilot for so many complex tasks?

How does one safely and effectively transition from one complex cockpit task to another?

How valid is the concept of integrated crew duties and will this solve the problem of complexity?

What is the proper line between man's authority and system authority if the point is reached where there are more subsystem tasks than man can handle?

How can one qualify the "worth" of simulation and where are the lines between the real world, actual training and simulation?

Once trained, how can proficiency best be maintained?

There are questions of a general nature which must also be answered before future training philosophy can be developed and new methodologies initiated. They are:

- *What can be learned from the other services?*
- *How much training degradation should be accepted for the sake of safety and still meet required performance standards?*
- *What impact will aviation requirements for the selection of large numbers of specially qualified personnel have on the rest of the Army?*

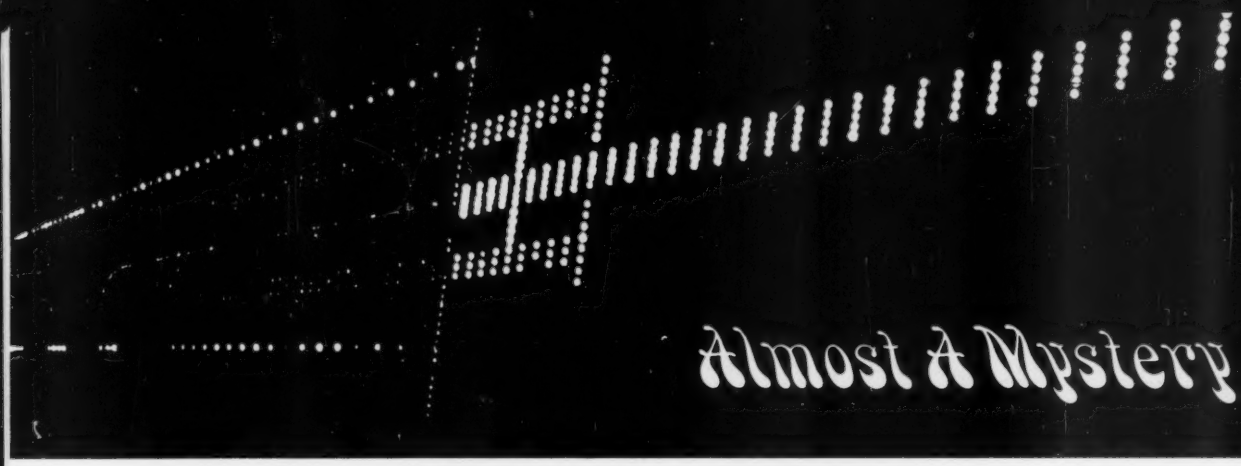
Priorities: The questions that have been posed are interlaced to such a degree that priority tends to become obscure. To prevent obscurity, the questions must be examined with respect to materiel priorities. The Combined Arms Combat Development Activity at Ft. Leavenworth, KS, regards the following aviation system improvements as important. In order of priority they are:

1. Attack helicopter
2. Scout helicopter
3. Aircraft self-protection
4. Night vision system
5. Camouflage efforts
6. Air traffic control
7. Concept for logistical support
8. Other systems

Rapid introduction of many of these materiel systems will have a significant impact on training. The behavioral research implications covered in this article have the greatest impact on the first four systems. Behavioral research for the scout and attack helicopters must serve to optimize each system by itself as well as the team. Specifically, the research should include the simplification, integration and reduction, plus the apportionment of workloads of the aircrews. Particular effort is required in the area of crew stress.

Night vision behavioral research must obviously parallel the design research of the scout and attack helicopters because both will be equipped with such devices. Particular emphasis must be placed upon the requirements for man/system interface and the associated stresses.

Conclusions: Behavioral research efforts will have a considerable impact upon future aviation, particularly aviation training. Current training philosophy is expected to undergo considerable alteration in many areas as a result of research findings. With the next generation of Army aircraft about to emerge, training methodology faces a similar future. A most important question then that must be answered is: Will present training techniques and training philosophy produce an effectively trained crewmember capable of operating the next generation aviation systems in the anticipated operational environment? Or must we develop a new training philosophy *now?*



Almost A Mystery

This belongs among those "worth remembering" stories you've heard or read in the past. The author relates, for the benefit of fellow aviators, a flight episode which made him a "believer" that experience is the best teacher . . . if you can talk about it

Captain Wallace C. Magathan III

OKAY, OKAY, you're right! I should confess the whole thing. Your article "Writing For The DIGEST" [March 1973 issue] brought it home to me; somewhere there is probably another guy like me who at sometime will do the same thing I did—only he may not be so lucky. Hopefully, when he does it fate will allow him a fleeting bit of time to recall that he read all about it in the DIGEST.

Had I been less fortunate about all the time I *would* have had would have been to say, "Whazzat?" I never would have had the privilege of knowing what got me. So, out of concern for my fellow aviator, whoever he may be, I tell my story.

It was a night like all nights, only I was there . . . flying a UH-1 to get my minimums. All I did was look down to change frequencies when out of the corner of my eye I saw a solitary light casting its soft glow on nearby trees . . . TREES?

But I digress. I had been back from the Republic of Vietnam 2 or 3 months and for the first time I was confronted with annual minimums. Among other things I had to get 7½ hours of nighttime before July. This being February, with its long nights, I figured I'd better get some time while the getting was good.

The flight to Montgomery was uneventful. With no moon, city lights and stars seemed suspended on the same textureless deep black background. I got the creeps thinking about engine failure but it wasn't the "slick's" engine that was out to get me.

A cup of coffee while the aircraft was being refueled found me thinking what a nifty thing Stage III Radar Service was—approach had kept me well informed of conflicting traffic, properly sequenced me in the traffic pattern and turned me over to tower where the only required conversation was, "Cleared to land, runway 27."

That brightly lit runway was an easy target, but Montgomery has more runways than 09-27—not lit of course since they were not the active. But I keep getting away from the story.

I cranked "her" up and gave ground a call—nice guy, he offered me runway 21, a lot closer to get to, more in my direction of flight and into the wind. I couldn't turn him down . . . 09-27 was still the active but only fixed wing have to worry about that.

Cleared for departure, I pulled a little pitch and the ground fell away beneath me. Dousing the searchlight I was immediately struck by the total blackness ahead of me. Was that a big lake ahead of me? Have to check it out in the daytime someday, I thought. What a contrast with the lights I'd left behind at 6 o'clock.

Contact departure control frequency 322.5 . . . oh yeah, that's Stage III. Let's see, doesn't seem to be a preset so I'll put it in the window. And then through the chin bubble that solitary light with those softly lighted trees a whole lot closer than they should have been from the altitude I should have been at. With alarm bells clanging I pulled the cyclic back and the collective up. Eyes forward

AVSCOM Comments
EGT vs OAT . . . And The Turbine Engine

In the September 1973 issue of U. S. ARMY AVIATION DIGEST it is recommended that pilots compare the EGT with the OAT gauge. I would like to point out that the allowable tolerance for the EGT gauge at 0 degree C. is ± 40 degrees C. This would allow readings to vary 80 degrees C. which indicates the EGT indicator was not designed for accurate readings at ambient air temperatures. The most desirable area for greatest accuracy is in the operational range preferably at the red line temperature. The Military Specification MIL-I-9443 for EGT indicators (Type MJ-2) requires the greatest accuracy at 700 degrees C.

The turbine engine engineers have determined where the greatest accuracy for the EGT gauge is required and the gauge must be adjusted for best accuracy at that temperature.

When the complete aircraft EGT system is tested using a Jet-Cal, slight adjustments should be made for greatest accuracy at the most critical temperature. Any large errors will require troubleshooting of the complete system. Any TMs that do not reflect the above should be revised.

Since accurate readings are unattainable unless better instruments are built at a considerable increase in price, consideration is being given to removing the lower temperature readings of the present EGT.

In the interim—pilots, take heed! Do not trust your EGT for static readings. Under no circumstances should the EGT gauge be adjusted to read the correct ambient air temperature.

GEORGE TATE
Aerospace Engineering Technician
U. S. Army Aviation Systems Command

now, I saw the runway gliding by —*lit only by my navigation lights* —just a few feet away.

Checking the instruments revealed the vertical speed indicator still indicating a rate of descent of 500 feet per minute. I was safely climbing now, though, and an old familiar feeling of great relief came over me, no less powerful an emotion than that felt in Vietnam after having survived a particularly risky gun run. I thought I'd left such feelings behind.

That night I learned that stupidity can get you. Here's my analysis of what happened.

Turning off the searchlight too soon gave no nearby ground reference at all since the runway lights were not on. Looking down to change frequencies robbed my peripheral vision of distant lights which I needed to give me attitude information. The only thing left to confirm positive rate of climb would be a "seat-of-the-pants" feel. Curiously, I had felt no change from the time I knew I was going up to the time I was going down. I figure that by unknowingly dropping the nose of the aircraft I had substituted the feel of gravity in a climb for forward acceleration in a descent. The illusion was perfect. Without that light to attract my attention I would have ruined runway 21 for the rest of the night.

Here are the lessons learned for night takeoffs, especially if you go solo:

• In the absence of runway lights or other good illumination keep the searchlight or landing light on until well above the ground.

• If you know you are going to have a frequency change or some such distraction plan for it. Either be able to do it quickly or put it off until safely above ground, notwithstanding tower's or anybody else's instructions.

• Consider the takeoff an easy instrument takeoff—but an instrument nonetheless. I found out it's easy enough to fool your pants, and even if you are looking your vision can get faked out too, especially in poorly lit areas. If you aren't monitoring at least the vertical speed indicator and altimeter, then you are as stupid as I was. And that was nearly dead stupid.

The author was assigned to the U. S. Army Aviation Test Board, Ft. Rucker, AL, when he wrote this story. Captain Magathan has completed ranger, airborne, rotary wing and Cobra training. He is a graduate of the U. S. Military Academy (BSc) and has 1,350 hours of aviator time

Researc
Ar
Avia

Many Army aviators are perhaps not familiar with the newly organized U. S. Army Air Mobility Research and Development Laboratory. In this article the author takes the opportunity to introduce AMRDL and also provide a glimpse of where Army aviation research and development is heading

Major James A. Burke
Research and Development Coordinator
AMRDL

THE HELICOPTER has provided the Army an unprecedented dimension to mobility that ultimately has removed many battlefield restrictions. As helicopter and other vertical takeoff landing (VTOL) technology unfolds into sophisticated aircraft systems, many aviators may wonder who is doing the "research homework" for Army aviation. For this task the Army has consolidated its aeronautical research assets with the facilities of the National Aeronautics and Space Administration (NASA) and formed what is now called AMRDL—the U. S. Army Air Mobility Research and Development Laboratory. The organization shown in the chart, with laboratory facilities in California, Ohio and Virginia, is a quantum jump for the Army aviation research effort.

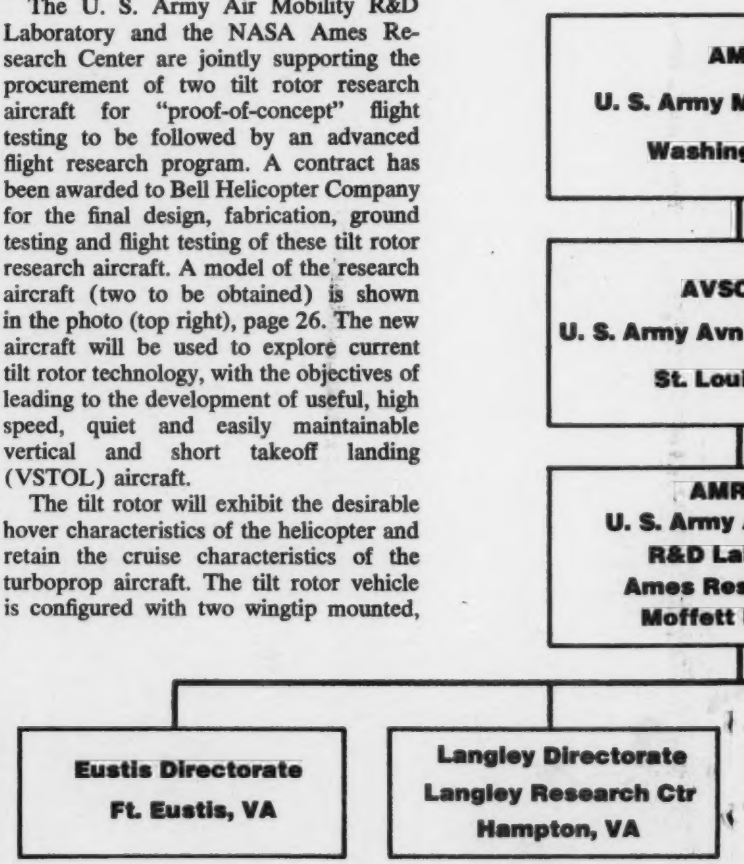
The unique feature of this organizational concept is the inter-agency relationship with NASA. Three of its elements (called directorates) are located at Ames, Langley and Lewis Research Centers. This provides the Army with direct access to the vast research facilities and expertise of NASA and mutually benefits both agencies in the performance of common research.

The encompassing mission of AMRDL is to plan, develop, manage and execute for the U.S. Army Aviation Systems Command (AVSCOM) fundamental research, exploratory dvelopment and advanced development programs up to and including the demonstration of technology. All this is necessary to provide the firm technical base for future development of superior airmobile systems.

AMRDL tackles this tough job through in-house research programs and contracts with industry, colleges and universities. Special emphasis is being placed on aircraft maintainability and reliability; improved rotor systems, stability and control; greater safety and survivability; better maneuverability; and performance ability.

The U. S. Army Air Mobility R&D Laboratory and the NASA Ames Research Center are jointly supporting the procurement of two tilt rotor research aircraft for "proof-of-concept" flight testing to be followed by an advanced flight research program. A contract has been awarded to Bell Helicopter Company for the final design, fabrication, ground testing and flight testing of these tilt rotor research aircraft. A model of the research aircraft (two to be obtained) is shown in the photo (top right), page 26. The new aircraft will be used to explore current tilt rotor technology, with the objectives of leading to the development of useful, high speed, quiet and easily maintainable vertical and short takeoff landing (VSTOL) aircraft.

The tilt rotor will exhibit the desirable hover characteristics of the helicopter and retain the cruise characteristics of the turboprop aircraft. The tilt rotor vehicle is configured with two wingtip mounted,



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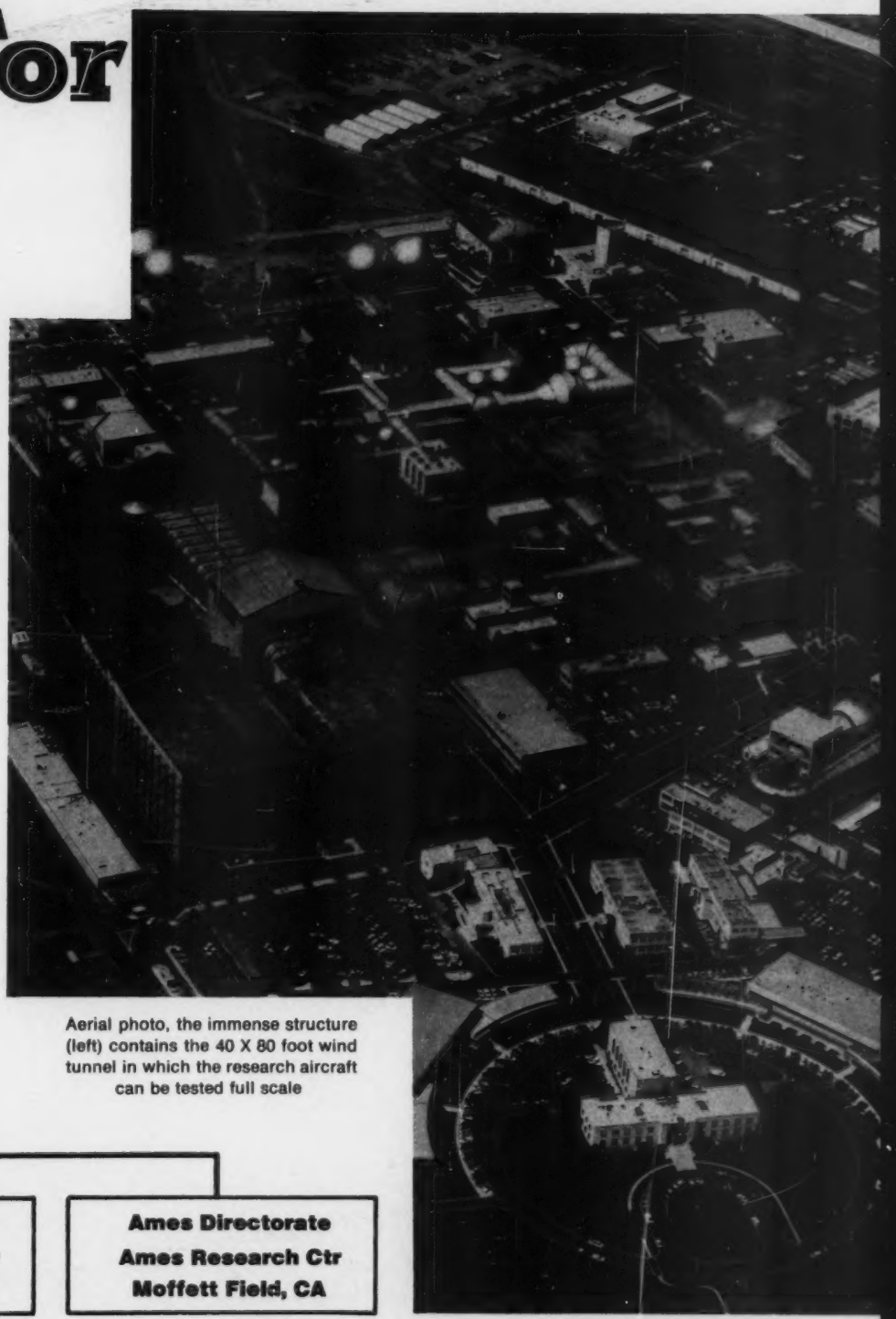
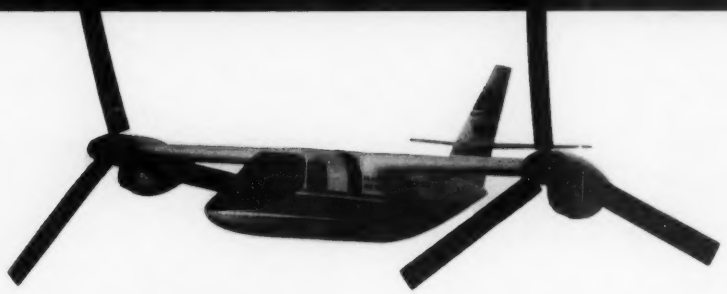


Aerial photo, the immense structure (left) contains the 40 X 80 foot wind tunnel in which the research aircraft can be tested full scale



Model of the tilt rotor aircraft to be obtained for "proof of concept" testing and advanced flight research program

low disc loading rotors. For most takeoffs and landings the research aircraft will operate as a VTOL vehicle with its two rotors in the helicopter mode. However, since it is being designed to operate at intermediate mast angles, its short takeoff and landing (STOL) characteristics may be investigated at high gross weights. The aircraft will be required to vertically lift a crew of two, a minimum of 2,700 pounds of payload (which includes the avionics and research instrumentation), adequate fuel for a 1-hour research mission (involving 3 minutes of hover), cruise flight and several takeoff and landing go-arounds for simulated instrument flight rules as well as visual flight rules missions.

The tilt rotor research aircraft, shown by an artist's drawing on page 26, is to be used eventually for general application investigations and, therefore, will be designed to perform extensive transition maneuvers to assess various potential military applications. During or after conversion to airplane flight the rotor speed can be reduced to increase propulsive efficiency. The cruise speed of the aircraft will be sufficient to demonstrate its aeroelastic static and dynamic stability characteristics over the range of speeds of interest for future commercial or military aircraft applications. As a goal, this speed is 300 knots. The aircraft will be capable of sufficiently higher speeds in level flight or dive to demonstrate adequate speed margins above cruise speed for rotor/pylon/wing stability. The aircraft will be designed with the capability for steep descent and climbout performance over a broad range of forward and vertical velocities.

The size of the research aircraft results from the requirement that it be the minimum necessary for adequate demonstration of proof-of-concept and for performing meaningful flight investigations. At the same time it must be large enough to permit extrapolation of research data in its application to future design of useful commercial or military tilt rotor aircraft. These requirements result in an aircraft in the 13,000-pound to 14,000-pound gross weight range using rotors 25 feet in diameter.

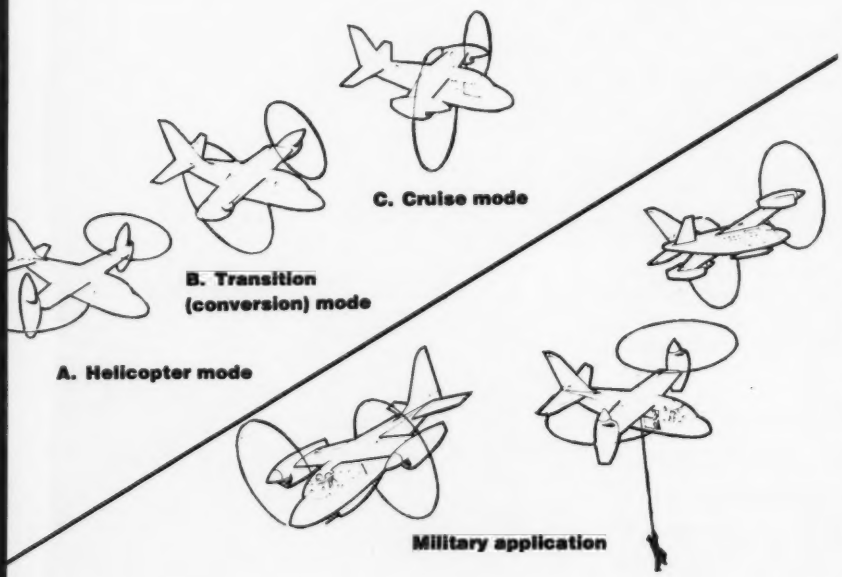
The aircraft's physical dimensions allow it to be tested full-scale in the NASA Ames Research Center's 40-foot x 80-foot wind tunnel shown in the aerial photograph, page 25. Overall dimensions of the tilt rotor are expected to be about 15 feet high, 60 feet wide and about 40 feet long. The wingspan is expected to be about 35 feet. The aircraft will be powered by two Lycoming T-53 engines.

So, as you can see with the expansion of AMRDL comes a new concept in air mobility called tilt rotor technology. Army aviation research has truly undergone some subtle changes recently. The future of other new aircraft systems also is unfolding in AMRDL.

While we in the Army may not have our very own aeronautical research complex, we do share the facilities of a professional partner called NASA.

Drawing below illustrates some of the maneuvers and military applications representative of those which the tilt rotor aircraft will duplicate

Typical Tilt-Rotor Aircraft



Aeromedic

Provided by the Society of U. S. Army Flight Surgeons

PILOT'S PHYSICAL FITNESS

Lieutenant Colonel Rollie M. Harrison, *Medical Corps*

The views expressed in this article are the author's and are not necessarily those of the Department of The Army or of The Army Aviation School.—The Editor.

Flying is a type of occupation that generally requires little vigorous muscular activity. Although this is true, it is also true that in pilots a constant state of readiness is required in antagonistic or opposite muscle groups. This is necessary to produce the delicately coordinated stick and rudder movements which are key factors for the accuracy and precision that are so important in flying, and which are dependent upon well coordinated responses in the muscles of upper and lower extremities. Although no great amount of muscular activity is expended in flying our modern aircraft, nevertheless, flying does produce fatigue in the personnel who operate them. Susceptibility and reaction to, as well as ability to recover from, this fatigue is influenced markedly by the individual pilot's state of physical fitness.

Many of our pilots have reached or passed the third decade of life, and too frequently have become so occupied with other duties that the thought of any program of physical training has long since been relegated to the limbo of forgotten things. Not only does this situation exist among our rated pilots, but it has influenced thinking and planning with respect to the training of Army pilots. Although highly necessary, no time has been provided in the curriculum for the inclusion of regularly scheduled and supervised physical training of our student pilots due to the press of cramming a plethora of subjects into too short a period of time.

The benefits derived from physical training are numerous. The attainment of good physical condition by correct and adequate exercise is very important. It is reasonable that the pilot who is in good physical trim will suffer less fatigue from a comparable amount and type of flying than the man who is in poor physical condition. Exercise of an organism produces growth and strength, disuse results in atrophy and weakness. The goals of exercise are the development of a strong and vigorous body with efficient circulatory, respiratory, and excretory systems to provide energy for activity, and to remove its waste products efficiently. Muscle tone throughout the body benefits from regular training and the desirable effects are reflected in greater resistance to, and more rapid recovery from fatigue, improved coordination and reaction time, better digestion and absorption of ingested foods, as well as improved bowel elimination. Planning, judgement, and even visual acuity may be favorably affected by a high degree of physical fitness.

Body functions generally are improved. Circulation of the blood supplies nutriment and oxygen to produce energy and rebuild tissues throughout the body, and to remove the waste

THERE ARE FEW experienced aviators in Army aviation who don't recall or haven't heard about the admonitions of a crusty and dedicated Army flight surgeon named Rollie M. Harrison. His impatience with belt buckles supporting more than pants has become legendary. The accompanying article, another U. S. ARMY AVIATION DIGEST classic, reveals that Colonel Harrison's attitude was reasoned and intelligent, not mere emotionality.

It is most appropriate that we harken to his words during these our most corpulent and abusive days. "Tis

LTC (Retired)
Rollie M. Harrison

products that are produced by this metabolism. Physical training develops the muscular power of the heart along with the other muscles of the body. It has been determined that the heart of the trained man pumps more blood per minute with fewer strokes than does the heart of an untrained individual. In the trained man there is a rapid return to normal of the heart rate after exercise, while in the untrained person a considerably longer time is necessary for the return to a normal state. Thus with training, the circulatory system becomes more efficient, with an increased oxygen and nutrient transport, a reduced heart rate and a more stable blood pressure that is less subject to marked fluctuations of degree, and an overall beneficial effect upon the whole organism.

Lt. Col. Rollie M. Harrison, who was Flight Surgeon for ARMAV, Ft. Sill, Okla., from 1950 to 1955, is enroute to Europe. He received his BS from the University of Ill. in 1929 and his MD from Northwestern University College of Medicine in 1935. He is a graduate of the AF School of Aviation Medicine and completed the course in tropical medicine at the Army Medical Center.

He is a member of the AMA, Chicago Med. Society, Ill. State Med. Society, Aero Med. Association, Association of Military Surgeons, AF Association, Airline Med. Examiners Association, and Masonic Bodies.—The Editor.

Respiratory efficiency is also favorably affected. Physical training brings about well defined changes in the respiratory system and its functioning. Chest expansion increases, depth of breathing is increased, and the rate of respiration is slowed. This has been proved by controlled tests in which trained men were shown to have breathed less air but to have absorbed a greater amount of its oxygen and also to have eliminated a greater quantity of carbon dioxide in expired air than did the untrained man. According to Bergin, "The athletic, average weight, physically fit person has a markedly higher altitude tolerance than the overweight or otherwise inferior individual, and a remarkable increase in altitude tolerance can be observed as a result of the institution of regular physical training exercise and an attempt to raise the general standards of physical fitness in a selected series of cases." He also suggests a lower state of physical fitness as a possible contributing factor in air sickness.

In addition to the beneficial effects already mentioned, exercise provides an outlet for the tensions and worries that build up in the daily activities of flying, particularly as concerns the student pilot or the operational flyer. McFarland says, "For men engaged in airline piloting, exercise relieves emotional tension and improves general well being far out of proportion to the actual amount of exertion involved."

Physical fitness is not entirely dependent upon exercise, although as previously indicated this is a very important factor. Of equal importance are the individual habits. Excesses of any nature are most undesirable. Overeating, excessive smoking, and the intemperate use of alcohol can be considered only as insults to the circulatory, respiratory, and digestive systems and when continued over a period of years, invariably exact

the season to be jolly" goes the strain of a popular Christmas melody. Not infrequently, we associate this jolliness with our fat friend, St. Nick. Together they embody the too often pervading theme of the holiday season . . . pickled frivolity and fatuous engorgement.

There is a dangerous period for those who cautiously guard against these refrains throughout most of the year . . . from that first mouthful of Thanksgiving Tom Turkey and all the trimmings to the last glass raised high for "Auld Lang Syne." The common resultant is a stout and weary countenance that requires months of ceaseless effort to resolve. Only by maintaining our guard during this period can we stave off the caloric and alcoholic assault on our body and brain cells.

What remedy does one call upon then? A preventive one of course! Either do or don't.

● DO increase your level of physical exercise. While a little bit of exercise doesn't compensate for excessive indulgence, a lot of exercise can take the edge off an otherwise overwhelming experience. Running at the rate of 7 miles per hour (close to an 8-minute mile) burns about 14 calories/minute. If you sustain that run for 45 minutes, you can burn 630 calories. That's almost ¼ of the dietary allowance for a 154-pound man over 22 years of age. Any kind of prolonged exercise will count—but do it, don't postpone it. Running from party to party in

your sports car spreading cheer just won't hack it.

● DO restrict your intake of alcoholic beverages. The more you drink, the more you tend to eat . . . "have to absorb that booze with something." Then the more you drink the more you tend to smoke. Finally, the more you drink the more likely you will end up with gastritis and other body fluid imbalances including diarrhea. What a way to celebrate the holidays!

● DO think twice about the cost of overeating and resultant obesity. If you consume twice the normal man's (2,800 calories for 154-pound, 22-year-old) or woman's (2,100 calories for 127-pound, 22-year-old) dietary allowance you can definitely gain weight even if you do the above. This kind of intake is not uncommon during the holiday season if one counts calories conscientiously. The result . . . you will get ugly fat. Your clothes and uniforms will not fit. You will feel sluggard and depressed. You will avoid mirrors, people and return to your previous exercise program at all costs until you run into your friendly Fright Scourgeon with weight scales and skin calipers in hand. We will then return to those haunting days and cares of yesteryear and Colonel Rollie M. Harrison. So read him well and read him with conviction and resolve. You'll not regret it.

Happy holidays,

Nicholas E. Barreca, M.D.
LTC, MC, SFS
Dep Dir, OAET, USAAVNS
Fort Rucker, AL

a toll in the form of impaired physical fitness and decreased efficiency.

Indiscreet eating habits are prominent on the list of causes for decreased physical fitness. The average adult person whose occupation requires only moderate physical activity undoubtedly consumes an excessive amount of food. This is apt to be true especially of persons in sedentary types of occupation. The amount of food required to maintain a normal state of nourishment and to provide adequate energy for the usual activity of flying is probably less than is consumed by the average pilot. Individual variations in ability to utilize food do exist, but in many persons overeating results in building up body fat and the creation of a weight problem which has many undesirable features. Statistics point to a rather direct relationship between dietary excesses and obesity, or overweight, and the incidence of hypertensive heart disease, gall bladder disease, diabetes mellitus, and gout.

The consumption of alcoholic beverages has no place in the maintenance of physical fitness. It must be remembered that alcohol is an irritant and a toxic substance with no food value although it is a source of energy. McFarland sums it up in this manner, "Although the oxidation of alcohol provides some energy for the body (about 7 calories per gram), it differs markedly from ordinary foods in several ways: (1) It can only be burned immediately and cannot enter into the building or repair of tissues or be stored for future use as a fuel. (2) It is not utilized more rapidly when the supply is increased. (3) No accessory food factors, such as vitamins, are present. (4) Alcohol has definite druglike actions and toxic properties not possessed by foods. (5) Severe organic and mental ailments may result if alcohol is taken in large quantities for a long period of time."

Many persons feel that a drink of whiskey or a cocktail gives them a lift when tired or depressed. It is true that a few drinks may produce a temporary feeling of improved well being, but by the same token, when the temporary effects have been dissipated the resultant let-down is apt to be greater than the reaction that prompted the drinking originally. Not only is this true but if the habit is developed, the amount of alcohol required to produce the desired effect will become greater, the subsequent depression will increase, and in a susceptible individual varying degrees of alcoholism may ensue, with a general and progressive loss of efficiency.

Sleep and rest must not be ignored in any discussion of physical fitness as they are most important in maintaining efficiency. During sleep the various body processes are slowed down and balances are restored in the internal environment. Particularly important are the adverse effects of inadequate sleep upon the higher centers of the central nervous system as manifested by increased irritability and impaired memory. Susceptibility to hypoxia or tolerance for altitude are progressively lowered by loss of sleep. Adequate rest and sleep are essential for the alertness, planning, and judgement that are required of the military pilot.

Physical fitness is a matter of great importance to the military pilot in that it connotes good health and has a direct bearing upon his general efficiency, term of useful utilization, and general well being throughout life.

A Briefing For The High Country

Army aviators should consult their current aircraft dash 10 and unit SOPs in conjunction with this article to preclude any possibility of performing nonstandard maneuvers

A MAN WHO HAS just got his license buys his first airplane and sets out across the high country of the West. It is his first big trip. As he loads in his wife and kiddies and the luggage we stand by, watching. "We" means the people who taught him to fly, gave him his license, sold him his ship. It also means the rest of us just fellow-pilots who happen to know some of the things he has yet to find out. Do we owe this man any advice?

I think we do. Too many new pilots come to grief on trips of this nature. And this is not from lack of flying skill. They have just passed their flight tests. Nor is it from lack of aeronautical knowledge in an academic sense. They have passed their writtens. In some respects they know more than they will ever use. It's more from a sort of innocence. They are not prepared for the real-life situations they will meet. They fail to recognize the problems, or, if they do, they have no solutions ready-made in mind. They lack (of course) experience. What's experience, other than that the problems are expected, the various solutions pre-thought-out? I think it should be possible to give the new man some advance knowledge of the problems and the solutions—equip him with some canned experience, so to speak. This is needed for many aspects of flying. Right here we'll try to do it for the high country.

FIRST OF ALL

What one thinks of first, of course, is the long fast takeoff run and the shallow, slow climb. Landings, too, are faster and longer in the high country, but not by very much. That's a cheerful fact—high country landings are no problem.

The big difference is in takeoff and climb. Responsible is the thin air, which cuts engine power and also reduces wing lift. And what's responsible for the thin air? Elevation and summer heat in about equal measure. Our new man should know this clearly. On a hot day, even a low level airport has thin air, and takeoff there is noticeably poor. On a cold day, even a high field has reasonably dense air, and takeoff is OK. Our new man will probably do his high country flying in summer, and he'll have air that is high *and* warm. His takeoffs will be poor.

The numbers can be picked off the clever Koch

Chart (civilian chart), and they are startling. At 7,000 feet, with the air at 100° F., the takeoff run is tripled, compared to sea level; the climb is only a quarter of sea level climb. These, however, are extreme values; the air at the higher elevations rarely gets quite so hot. And the airport designer, too, has consulted the Koch Chart, and has lengthened his runways to allow for the power performance. So if our man uses a regular airport, widely used by all sorts of airplanes, he has nothing to worry about. He need not be scared: just aware. He should be mentally prepared for the long takeoff run and a very shallow climb. He needs no more skill, just a little more patience. He should not try to pull the airplane off too soon, or to climb it too steeply. Perhaps, before his trip, he might want to have his wheels balanced with more than usual care. If there is any wheel shake or shimmy, the higher speeds of those takeoffs make it much worse and this then makes you hurry your takeoff.

MIXTURE

Only one point of special technique is needed. Above 5,000 feet or so, lean out the mixture right on the ground *before takeoff*. At high elevations, on a hot day, our engines drown in fuel. The Koch Chart shows the performance of airplanes with the mixture *right*. The mixture, too, responds to both elevation and air temperature. That performance is poor enough. With an over-rich mixture some airplanes may hardly get off. *This* effect of thin air, via the mixture, may have caused much trouble in the past. It's been a semi-secret. Pilots were taught to have the mixture full-rich for takeoff. Owners Manuals said: Don't lean the mixture until above 5,000 feet—and then only for cruising, not for climb. Renter pilots were told: Leave that thing strictly alone. On some rental airplanes the mixture control was safely wired in the full-rich position. Nobody wanted to say it—lean your mixture. The reason was, of course, that a lean mixture while using full sea level power can damage an engine, can even cause engine failure right on the climbout. Nobody wanted to be responsible, let alone liable. Well, the fact is—the double-fact is: (a) at 5,000 or above, the power output of the engine is so restricted anyway that you are not so likely to damage it even by leaning excessively; (b) the mixture runs so excessively rich at 5,000 feet in summer on the ground that you can lean it out quite a lot—with a marked gain in power—and still be safely on the rich side. You don't really lean it; you de-rich it. And of late, some Owners Manuals have begun to say it under "Engine Check Before Takeoff." "Above 5,000 feet, adjust the mixture."

HOW TO LEAN

This leaning out is not hard to do—brakes held, wide open throttles or nearly so, move the mixture gradually until you get roughness or a drop in rpm. Then rich it up again "some" to be safely on the rich side of Best Power. With an injector engine you also lean out steadily, but from time to time give it a quick small forward (enriching) shove on the control. When this surge of enrichment causes a surge of rpm, you know we're past Best Power on the lean side: you richen it up some and there you are. With an exhaust temperature gauge, of course, it's easy.

The biggest problem at some fields may be to find a place where you can rev wide open without sucking a lot of gravel into your propeller. One therefore learns to do a fair enough job just by putting the mixture control where one thinks it ought to be. With a little practice, you can also adjust the mixture during the takeoff run. It is not necessary, after all, to have *the* absolutely best power—just so the poor thing isn't suffocating. The thing to remember is that an airplane climbs on the power it has to spare, over and above the power it needs to maintain airspeed. Therefore a 10% increase in power may well mean a 20% or even a 30% improvement in climb. The more under powered and/or heavily loaded the airplane, the bigger the improvement.

FLAP USE

Flaps on takeoff? At high elevations, this is a problem. Flaps get the wheels off the runway sooner, thus reducing friction, and that is a gain. But flaps reduce the rate of climb, and that is a loss you sometimes can hardly afford. Probably the best way is to take off with some flap, then immediately, as soon as airborne, retract them—slowly. This takes a little practice, and familiarity with your airplane. In a low powered, heavily loaded airplane, with the flaps partly down you may get into an unpleasant situation. The airplane climbs quite nicely to the top of the ground cushion, say 20 feet or so. At that altitude you now pass the airport boundary. But now the airplane pauses in its climb. This is very unpleasant. The airspeed is low. The drag of the flaps keeps it from building up. The ground is too close, and maybe too rough, to do much nosing down. If you just retract the flaps you might get a sink right to the ground. If you keep them on, you'll be a long time picking up a healthy airspeed.

A BRIEFING FOR THE HIGH COUNTRY

LOADS

All our small airplanes are being operated all over the West with no restrictions as to gross weight. But our man will operate under the least favorable conditions. The local man flies, as he drives, with his machine half empty much of the time. Our man will probably be heavily loaded. The local man flies the year around, and has the benefit of much cool air. Our man will probably come through the high country at the hottest time of the year. And he will be a stranger.

Our new man should understand that a 10% reduction in an airplane's gross weight (not "load") improves the climb by more than 10%. (This is because there is less weight to be lifted, and at the same time slightly less forward speed to be maintained; so that there is slightly *more* power available for lifting *less* weight.)

For the stranger, in summer the finest special equipment to put into an airplane is an empty seat.

AIRSPEED FOR BEST CLIMB

Our man should accurately know his airplane's speed for best rate of climb. Not all do. In ordinary flying we do not use this speed much. We usually climb at higher airspeeds, for good cooling: sometimes, briefly, at lower airspeeds, for best angle of climb. But in the high country, speed for best rate of climb becomes important. Near its ceiling, an airplane climbs only at that one speed. The speed is shown in the Owners Manual—a slightly different value for each altitude, air temperature and gross weight. For practical purposes one figure is enough—perhaps the one for 10,000 feet in standard air. Better to have one figure in mind, than a whole set of figures in the glove compartment. Still better to make a chalk mark on instrument panel, opposite the right place on the rim of the airspeed indicator. Such a mark has persuasive powers at anxious moments.

THE TURN TOWARD LOWER TERRAIN

This is the emergency exit from bad situations. If you can't climb any more, or get a sudden sink, you turn toward lower terrain. It's really obvious. The trick is at that moment to be in a position to do it! The Western pilot avoids sticking his nose into any place where such a turn cannot be made. He flies across a ridge slope-wise; in flying up a canyon or narrow V-shaped valley, he holds to one side; he always keeps that turn open. He is not afraid to fly quite close to terrific mountain walls and cliffs—provided he can keep them at his side, not in front.

DOWNDRAFTS

With your rate of climb so poor, it is often futile to fight a downdraft by trying to out climb it. The climb, by slowing you up, keeps you in the downdraft longer; and the net result is *more* sink. Better, usually, to put the nose down a bit, pick up some speed and get out of there in a hurry. (We avoid the word "dive" because it sounds too wild. There are mountain situations with rough air when you want to avoid high airspeeds, because you might get hit by a gust.) Our new man should understand the technique of the soaring pilot who puts his nose *down* in the downs, holds it *up* in the ups. That way, he spends less time in the downs, more time in the ups, and absorbs energy from the atmosphere. The pilot of the small airplane can do the same, or at least avoid doing the contrary.

THE LANDING AT HIGH ELEVATIONS IS NO PROBLEM

This is a most pleasant fact and our man should know it. It will put him at ease. Many people almost naturally assume that the high elevation landing is stretched out in the same proportion as the takeoff is. If this were true, we *would* have a problem! But it is not true. The mountain air does *not* stretch the landing in the same proportion as it stretches the takeoff. If a high elevation airport is big enough for takeoff, it is super-ample for landing.

I think we should tell the new man: forget the elevation. Land as you would at home. That's what everybody ends up by doing. Specifically: *make your approach at the same indicated airspeed as you would at home* under similar conditions of turbulence, load, and field length. If the airspeed indicator feels the same, the wing feels the same, and the airplane power-off behaves the same.

It is true that there are some fine points of difference. The glide (true airspeed) is faster, by maybe 20% than at sea level; the landing is faster, and the landing run is longer. Bumps in the runway are a little more noticeable. So are the imperfections, if any, in the pilot's technique—bounces, drop-ins, not taking all the drift out. The glide angle, power-off, is a little steeper, because at the higher true airspeed, the idling engine exerts more drag. The flare-out is a shade different, owing to the higher true airspeed and the slightly steeper glide angle: it is as if you were landing a slightly more heavily wing loaded airplane. But these effects are not highly noticeable. In fact, it is hard to demonstrate them. I think they fall within that band of errors and uncertainties that accompanies any approach and landing—up- and downdrafts, wind

gradient effect, small errors of judgment—the pilot is all primed in any case to take care of them. Something tells him he needs to drop the nose, to apply a bit of power right now, etc.: there high elevation effects wash out in this more general uncertainty. And the practical truth is that there is no important difference between a power-off approach and landing at sea level and the same maneuver conducted at 7,500 feet.

A WRONG IDEA

A lot of airplanes are bent in the high country because the stranger, fighting imaginary dangers, burns them on at high speed. You know how it is; he adds a couple of knots for the wife and kiddies, and a few for gusts, and a few more for being a stranger. Maybe his instructor built in a few extra knots at the outset, by never teaching him a slow, tail-down landing. If he now adds 10 knots for thin air, it really is too much!

A psychological factor then comes into play. In the over fast approach and flare-out, the airplane is too responsive and jumpy. It reacts to turbulence too strongly, and also to the controls. The pilot wobbles and over-controls as he floats and floats. This, in turn, produces a sort of synthetic turbulence; and that makes him want to use still more speed! That way you get one of those landings where the airplane is light on its main wheels, and the brakes don't hold. Perhaps the airplane "wheelbarrows" on the nose wheel and sidles off the runway.

So I think we should advise the new man: "land as you land at home." No tricks, of course. No attempts to pull off a real short landing. By all means allow extra speed for extra weight, allow for being a stranger, allow for turbulence. But do *not* allow extra for the thin air. That allowance is already built into the behavior of the airspeed indicator.

Once this is understood and really believed, we are free to tell our new man about some aspects of high country landing that are a little different.

THE MIXTURE AGAIN

If the pilot goes by the low level book—mixture full-rich, carburetor heat on, flaps down—he will be in poor shape for a go-around. He would have to get his flaps at least partly up, his carburetor heat off, his mixture leaned out, before he could do much climbing: he might forget one of those items, and get into trouble trying to climb in an airplane that won't do it: So we should tell him—on the approach, keep your mixture properly "de-riched"; use carburetor heat only as really needed; and in case of a go-around, don't forget the flaps.

THE POWER APPROACH

To maintain the same descent slope as at sea level, and the same indicated airspeed, the airplane needs *noticeably* more power than at sea level. (Since for the same *indicated* airspeed our true airspeed is about 20% faster, we need about 20% more rpm than we need at sea level.) This makes a lot more noise. It *sounds* like a lot more extra power than it really is. It shouldn't really matter because, in any case, what we do in a power-on approach is to maintain the airspeed with the elevator and adjust the throttle experimentally so as to get the desired angle of descent. It ought to make no difference to us that here in the high country we wind up with the throttle a little further forward, and a little more buzz.

It is not difficult; it is merely different. But in our flying we rely a lot on things *not* being different. We expect certain numbers, certain noises, certain control positions and pressures, to get us certain results. And when they don't we may be a little slow in noticing it. So, in this case, our man will probably get a little low before he wakes up to the need for more power. And now, having got a little low, he will have to put on an *extra* lot of extra power to get in.

This happens, I think, to everybody. Some let it undermine their confidence in the mountain air. "Gee," they say, "this air is so thin— if you didn't use a lot of power, you'd drop right in." Not so. A power-off glide would have come out perfectly normal. A *power* glide needs a little more power, that's all.

SLOPE

Naturally, in mountain country many runways are uphill or downhill. Naturally, one would like to land uphill. But this may mean a tailwind. What to do?

Rule: Slope is more important than wind. The higher the country, and the heavier your load, and the less high powered your airplane, the more so. Western pilots land uphill, take off downhill, almost regardless of wind. They accept quite considerable tailwinds. If the tailwind is *too* strong, they don't use that field that day.

Of course, everything depends on the how much: how much slope, how much wind, load, elevation, power, etc. It is impossible to give a rule. Besides our man would find it difficult to judge slope and wind velocity from the air, so a rule would do him no good. But we should bias his mind: respect for slope, comparative disregard for wind.

Slope is a help, not a hindrance. It is what makes those glacier landings possible. Because of slope, runways which look too high or too short on the map may be quite comfortable. Unless you know the

slope, the published runway lengths have little meaning and usually make the field look worse on the map than it is in reality.

COMMITTED

The uphill landing has a string attached to it: *you can't go around.* At least, not with a low powered, heavily loaded airplane, at high elevation, and if the slope is strong. Here again, everything depends; but if our man tries to go around where he shouldn't we would have the makings of a bad accident. The terrain rises faster than he can climb. He can't turn, at least not quickly, because the extra drag of the turn would stop his climb altogether. It is a good situation to stay away from. What follows? Or rather: what comes first? Our new man should be briefed. On the final approach to a markedly uphill landing there comes a decision point. If he goes on down beyond that, he can no longer go around; he then must get the airplane on the ground—even if this means, perhaps, overrunning the end of the runway and bending something. Fortunately, he is quite unlikely to overshoot an uphill landing, for reasons which follow.

LANDING WHILE CLIMBING

Uphill landings require extra airspeed.

The flare-out to an uphill landing is a super-flare-out, so to speak: you bend the flight path from downward not only to level but to upward. This takes extra airspeed, or else a blast of extra power during the flare. The usual story, the first time, is that the pilot at the last moment runs out of airspeed and/or elevator control, and makes a hard, bumped-on landing. Well, forewarned is forearmed. A blast of power at the right moment will remedy the trouble. An extra few mph of airspeed, on the approach, will prevent it. So what seems like a difficulty is actually a pleasant fact. It makes life easier. On the approach to an uphill landing you can afford an ample airspeed and still not float a long way. If you do float, the float, too, is uphill and therefore short. The landing run, too, is uphill. This is one reason why, on an upslope landing, a tailwind is quite acceptable.

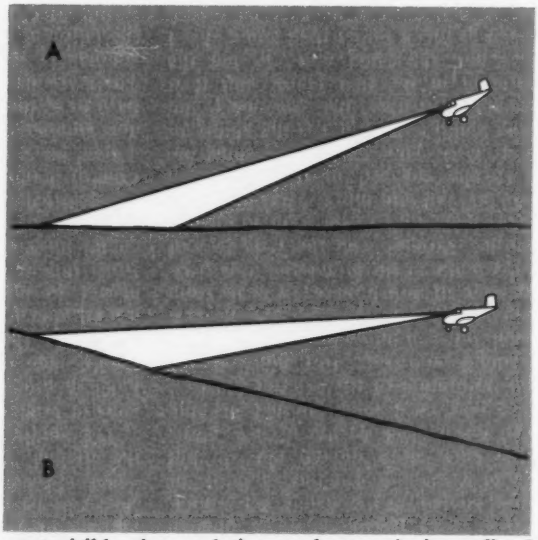
TILT

An optical illusion makes you fly low and slow.

In the final approach to an upslope landing, the pilot is powerfully beset by an optical illusion. He thinks he is higher than he really is, relative to the intended touchdown point. He also thinks he is more nose down than he really is. He therefore flies lower and slower than he intends to fly. What brings on the illusion is that the runway slants up, but the pilot's eye/mind interprets it as being level. Tilt!

This is illustrated here. Note that picture A is simply a copy of picture B, tilted exactly the way the pilot's mind tilts the situation. Picture A is the illusion. Picture B is the reality. Note that the runway appears to the pilot in exactly the same perspective in both cases. It also appears at the same angle underneath the airplane's nose, in both cases. All that is needed is the mental tilt, and it will make the pilot misjudge position and attitude by quite a lot. It is a powerful illusion.

There is another version of the same thing—even more sneaky. The airport lies on a smooth plain, many miles from any mountains. The runway does



not visibly slope relative to the terrain immediately surrounding it. But the whole plain is sloping up quite strongly toward those distant mountains. Your eye does not appreciate this slope—at least, not fully.

IN PRACTICE

The pilot has two ways to break the power of this optical illusion.

1. Pay attention to his airplane—his airspeed indicator, his trim, his stick forces. "Attitude flying" is no good if you judge your attitude from a phony reference!

2. He should let his eye sweep over the *whole* scenery, instead of getting too hypnotized by the perspective of the runway. His eye will then usually perceive the slope of runway, the slope of the plain upon which the airport lies, the whole lay of the

land. The optical illusion will be gone. Will it? Perhaps not quite. It is very powerful. It works on you even when you know what's happening. It sort of sucks you down.

What is the effect? Here again, it takes the pilot a little time to realize what's happening. (It will take him less time if we have forewarned him.) By the time he wakes up, he is quite low and perhaps quite slow. He now will have to add a lot of power to drag himself in. I have sometimes goofed so badly that my "final" was really a stretch of level flight, across upsloping terrain, to the touchdown point. This sequence of events—the optical illusion that puts you down, the delayed reaction, the subsequent need for a lot of power—may be another reason why people sometimes claim that the high country air doesn't hold you up properly. The contrary is true. The mountain air is OK! The best way to calm down one's approaches and avoid that last minute roar of power is to plan a high, steep approach, using little or no power. "Land as you would at home."

TAKEOFF OR LANDING

When in doubt about some ranch strip or other nonstandard field, why not try it first alone? Park the family and try for yourself, light. Then, when you have the measure of the field, come back and ferry people and luggage, maybe in two trips. This is only common sense. But in the real-life situation it sometimes does not seem to occur to people that they have that option.

EN ROUTE

What can we tell the new man, beforehand, that will be useful to him in high country? It's difficult. Flying is flying and air is air, and once we are up and en route it makes less difference what the country is like. On the other hand, all the factors are so variable; terrain, weather, season, airplane, load. It seems almost impossible to say anything except "Take it easy."

Just the same, there are tendencies for things to behave in certain ways.

ROUTES

Clouds, showers, thunderstorms, snow showers tend to build up over the mountains first, and sometimes over the mountains only, leaving the valleys clear for easy flying. It is therefore much easier to follow the early transcontinental airways—which, in turn, followed the early transcontinental railroads, which, in turn, favored the low and flat passages.

For the same reason, it pays to cross the big humps early in the day, and perhaps cross them where they are lower. On any particular trip this may turn out to be poor advice. On enough trips, it will average right.

THE WINDS

Local winds tend to blow up the slopes in the daytime, down the valleys at night—provided, of course, the overall wind is not so strong that it overpowers those local tendencies. Turn-around time is before sunset. By sunset a strong local breeze blows down many canyons. This is the best time to land on a canyon or valley runway—upwind, upslope. The best time for takeoff downhill but not downwind is midmorning after the downhill winds have stopped, but before the air gets too hot.

The higher the country, the tougher it can get. It is not always tough. It can be calm, sunny and smooth among the big summits. But it can turn tougher, faster, in the really high country. The airplane's performance is poor. The weather is more inclined to violent changes, cloud buildups, snow showers, strong winds, downdrafts, turbulence.

ROTORS

In the very high country, Sierra Nevada, for example, or the Rocky Mountains west of Denver, on days with strong winds aloft, you are in the region of Standing Waves or Lee Waves, and their associated "rotors." Here, small areas of really extremely rough air can be found; sometimes with clear air, sometimes with generally smooth air all around. It pays to be suspicious.

More airplanes have been lost in those very high sectors than seems explainable by the standard causes —weather, engine trouble, out of gas, etc. In my personal opinion rotor turbulence got some of them. We should caution the new man: Flying at mountain peak level on days with strong winds aloft, be cautious. How? Don't build up high airspeeds, even though the air at the moment may be smooth. And tighten the seat belt down hard, so you don't suddenly hit the roof.

IT'S TRUE

What else? Oh yes: all that propaganda about oxygen above 10,000 feet—it's real.

Lack of oxygen really does make people unobservant, stupid, and clumsy. And this sad state really is not noticeable to the pilot himself.

That sums up what I think the new pilot can usefully be told, beforehand, about flying in the high country. It assumes that he knows how to fly an airplane, knows VFR from IFR, knows about line-of-sight reception of omni ranges, and generally is a man of sense.

Can we put information of this sort into a sort of

checklist? I have tried that in the following bunch of questions and answers. The idea is that an instructor or more experienced pilot could ask the questions. For that matter, anybody could. If our man can recite the right answers, we can consider that we have prepared him for his high country trip—*so far as this can be done with words.*

Note that there are no explanations. If our man believes our statements he will think out, argue out, or read up on the reasons. There are no trick questions. We are not trying to deepen our man's understanding of flying, let alone test it; we merely want to make sure he has in mind, ready for use, certain ideas, facts, possible courses of action, that may be of value to him.

Note that there is little imperative in this checklist. It is not our purpose to admonish anybody to be good. There's too much of that around! There also are no skulls and cross-bones, no "Always" and no "Never." What follows is awfully mild and bland. May it be useful.

Q. What is the main difference in airplane performance at high elevation fields?

A. A long takeoff run and a shallow climb.

Q. What is the cause of this performance loss?

A. Thin air, caused in about equal parts by high elevation and high air temperature.

Q. What can a pilot do to make up for some of this performance loss?

A. Keep his load light. Take off at times when the air is cool.

Q. What special pilot technique is needed for high country flying?

A. Adjust the mixture for best power before takeoff. Do not return the mixture to full-rich for the landing approach.

Q. At what airspeed does an airplane have its best rate of climb?

A. The speed is different for each airplane. It is slightly different for each altitude. It is shown in the Owners Manual. For my airplane at 7,500 feet, on a warm day, it is 88 mph (indicated).

Q. What is the effect of flaps on takeoff?

A. They shorten the takeoff run, but lessen the rate of climb.

Q. When a pilot encounters a strong downdraft what should he do?

A. Instead of trying to out climb the downdraft, he should pick up speed and fly out of the downdraft.

Q. When flying close to mountains, what is the main safety rule?

A. Stay in a position to turn toward lower terrain.

Q. In a landing approach at a high elevation field, what should the airspeed indicator read?

A. The same it would read at a low elevation airport under similar conditions of load, wind, and turbulence.

Q. Is a power-on approach to a high elevation field different from a power-on approach to a low elevation field?

A. More power is needed to maintain the same indicated airspeed at the same angle of descent.

Q. If a runway has a strong slope, what is more important—wind direction or slope?

A. Slope is usually more important than wind. You land uphill, take off downhill almost regardless of wind. If the unfavorable wind is too strong, you don't use that field that day.

Q. Does a sloping runway present a problem to the pilot?

A. On final approach for an upslope landing there is an optical illusion which makes the pilot think he is higher than he really is and more nose-down than he really is. This tends to make him fly too low and too slow.

Q. In landing uphill on a markedly sloping runway pilots often experience a last moment surprise. What is it?

A. They find they have insufficient airspeed to accomplish the uphill flare and they make a hard landing.

Q. In landing uphill at a strongly sloping field, what should the pilot have in mind as he "thinks ahead of the airplane?"

A. Do not attempt a go-around toward rising terrain ahead.

Q. When in doubt about takeoff or landing at some high elevation field, what is a good course of action?

A. Try the field first alone, with a light load.

Q. Is anything predictable about mountain weather?

A. Clouds, showers and snow flurries and thunderstorms often build up over the mountains while the valleys are clear.

Q. How do you choose easy routes through high country?

A. The lower, flatter routes often have better weather.

Q. What is usually the best time to cross big mountain ranges?

A. Early in the day.

Q. What is the effect of altitude on the pilot?

A. Above 10,000 feet unless the pilot takes oxygen he becomes unobservant, stupid, and clumsy. Above 12,000 the loss of ability is severe. It gets worse the longer the pilot stays at altitude without oxygen.

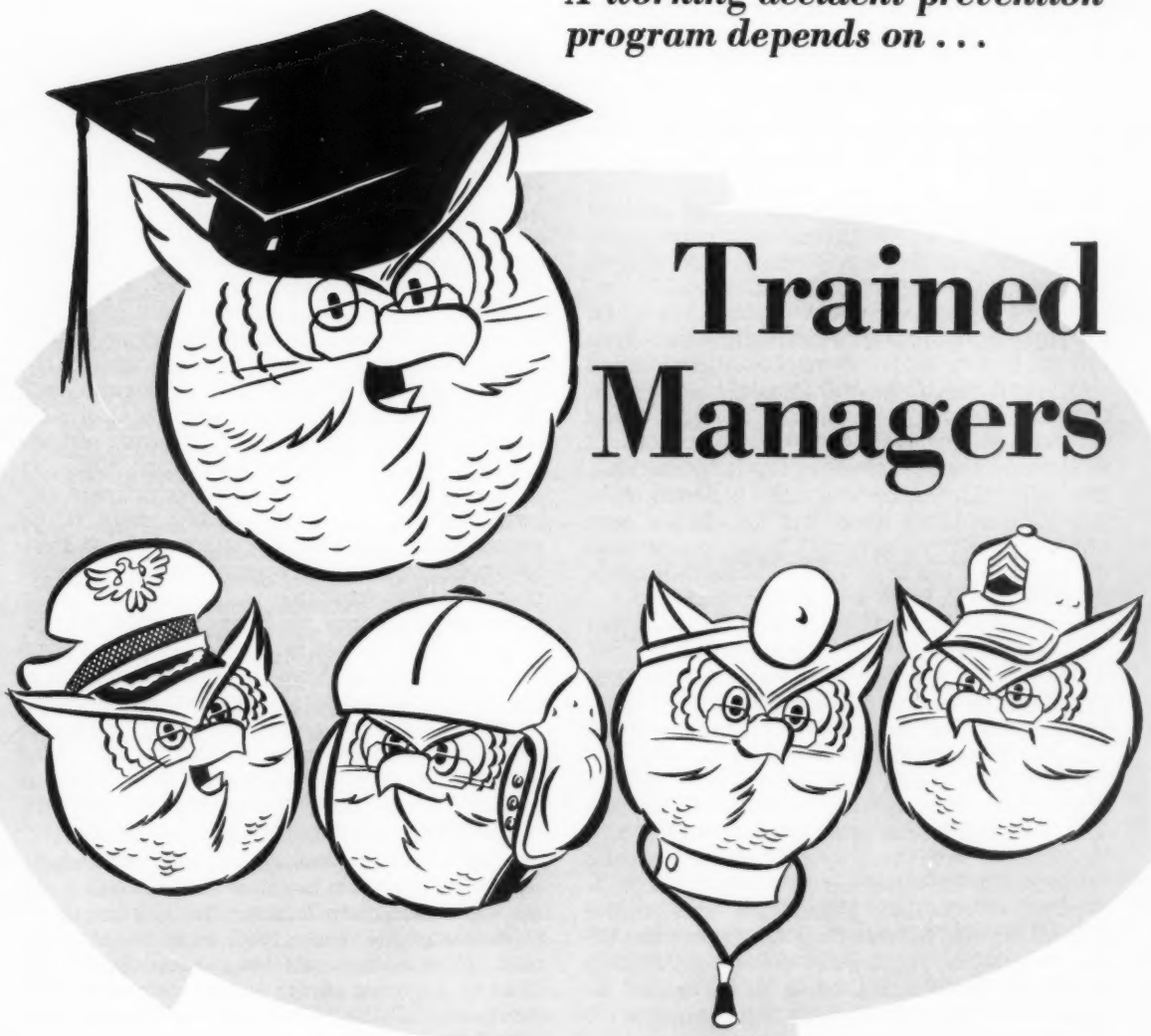
Q. Is this loss of ability noticeable to the pilot himself?

A. No.

David G. Holmes
Directorate for Education and Prevention
USAAAVS

A working accident prevention program depends on . . .

Trained Managers



A WORKING, structured, well-managed aviation accident prevention program is no accident. If your unit does not have such a program, and you haven't had an accident, then the odds are definitely against you.

As well worn as the opening sentence is, there is a key word you may not have given much thought to before—that word is *"managed."* Your personnel officer is a manager with inputs and outputs, spaces to be filled and records and reports to be kept. Obviously, your operations officer is a manager with commitments to be met and assets to allocate, with

limitations of both men and machines to be considered. The same is true for your maintenance officer.

Now what about your aviation safety officer? He is also a manager. If he just walks around shaking his head, pointing his finger, making reports of investigations, holding meetings and visiting the flight surgeon, no one could call that management, could they? You're right, and if that kind of program has prevented accidents for you, it's more accidental than you realize.

Specific elements are required for any well-managed program. These basic elements remain the same, whether for operations, supply, maintenance or safety. What are these elements? Command emphasis is first. Imagine what would happen if the commander did not ask about his maintenance program or check on operations for 2 weeks. A similar lack of command interest in the safety officer produces the same results.

The second element is training. You can't expect good management from your maintenance officer if he has not been trained in maintenance administration. The same holds true for your safety personnel. Have your aviation safety officer and his assistant been properly trained in their jobs? If not, maybe that's the reason they just walk around shaking their heads, reading safety literature and talking to themselves.

Many other elements are required for a sound aviation accident prevention program, but it is not practical to list them here as each unit may have features which call for unique elements. Suffice it to say at this point that an accident prevention program must be structured and this functional structure must be managed by trained personnel.

USAAAVS has long recognized this need and, with this in mind, a formal education program has been developed to better train aviation safety personnel. Because each individual has the ability to think for himself, our education program has been oriented towards showing the man the need, helping him define the problem, showing him the actions necessary to solve the problem, supporting his requests for assistance, then leaving it up to his own ingenuity to do his job in the proper manner.

USAAAVS began safety education during early 1964 and safety training is now available to aviation personnel of all grades. There are four major programs for training your safety personnel. In addition to the value-proven area of training concerning hazards, investigating and reporting, these four programs now place emphasis on providing the individual with the basic knowledge of *managing* an accident prevention program.

USC

The most comprehensive of these courses is the 12-week Aviation Safety Course conducted for the Army by the University of Southern California. This course trains the individual to identify problems of aviation safety and see actions necessary to solve these problems on a unit level. Active Army and Reserve/National Guard warrant or commissioned company grade rated aviators are eligible. Selection for attendance is competitive and is limited to aviators filling or scheduled to fill positions as unit safety officers, and Department of the Army civilian flight instructors and safety directors of major commands or installations having assigned aircraft, as specified in DA Circular 351-51. Two classes run concurrently, with approximately 25 students in each class. Quotas are allocated by the Department of the Army and obtained through your local schools officer. This is an MOS-awarding course: 7423 for commissioned officers and special qualification identifier suffix "B" for warrant officer flight safety technicians. In addition, the student receives 16 semester hours of undergraduate college credit.

The major subjects are Safety Program Management, Human Factors in Accident Prevention and Aviation Technology Applied to Accident Prevention. The subcourses accentuate investigation, aviation psychology, aviation physiology, aircraft structures and aerodynamics. As might be expected, high school level physics and mathematics is desirable, but many students have successfully completed the course without this by making a serious extra effort.

In addition to the management elements the prospective safety officer learns to work with, he learns the importance of feedback to the growth and improvement of any system, particularly the safety system. Just as a man could never learn accurate rifle firing by mastering aiming and trigger pulling if he never saw where the bullet hit, likewise accurate feedback in the form of thorough and complete hazard and mishap reporting is an essential element of his middle management position of safety.

AAPC

The second of these education courses is a 2-week Aviation Accident Prevention Course conducted by

USAAAVS' Directorate for Education and Prevention, Ft. Rucker, AL. The graduates of this course supplement the active Army and Reserve component requirements for ASOs which is not filled by the 200 annual USC graduates. This course is available to all Army aviators of the active Army or Reserve components and DA civilians associated with the Army safety program. Attendees of this course are provided with the basic skills necessary to fill unit aviation safety officer positions, using their training in aircraft accident prevention management, communications, regulations, and performance and petroleum handling. Additionally, instruction in human factors points out to the prospective safety manager that while he cannot monitor each individual's actions continuously, he can, through knowledge of human stress factors, assist his commander in identifying potential hazards associated with human error. This aspect of management control can be successful only by mastering the technique of getting things done through others. Other subjects taught in the AAPC are hearing conservation; structures; shop, flight line and maintenance accident prevention; armament safety; and airfield and facility surveys. Students are taught the techniques of accident investigation and reporting, and are able to visit the USAAAVS Directorate for Management Information System, which compiles and records all data concerning Army aircraft mishaps. The overall theme of the course is prevention. Emphasis is on conserving aviation resources through continuous prevention efforts based on a sound management program.

AAPMC

The third thrust of the USAAAVS education program is the Aviation Accident Prevention Management Course. This course is directed towards specialists and NCOs in grade E6 or higher. Any who may have a direct concern with aviation accident prevention through operations, maintenance or training are welcome. These people may or may not be given the additional duty of safety NCO upon return to their units, but the management philosophy and techniques which they learn are applicable at any level of responsibility.

Some of the subjects taught in the AAPMC are petroleum handling, maintenance-related accident prevention, shop and flight line safety, accident prevention surveys and armament safety. Normally, 10 classes per year are scheduled for the Aviation Accident Prevention Management Course and the Aviation Accident Prevention Course held at USAAAVS. Quotas are allocated through major commands. Interested individuals should work through their supervisors to attend the schools.

EDUCATION TEAMS

To ensure that *all* units which have a need or desire to improve their accident prevention programs are given the opportunity, USAAAVS provides educational teams to travel to these units when requested. The course content may vary as dictated by the length of time allowed or the type unit and its needs, i.e., a National Guard unit may arrange for a 2-day course to coincide with its drill periods; or the course can be modified to emphasize the problem areas of a unit's aircraft, environment or operational mission. The education team is scheduled through direct liaison with USAAAVS. There is no cost to the requesting unit, which is required only to provide a suitable classroom, projection equipment and no fewer than 25 students.

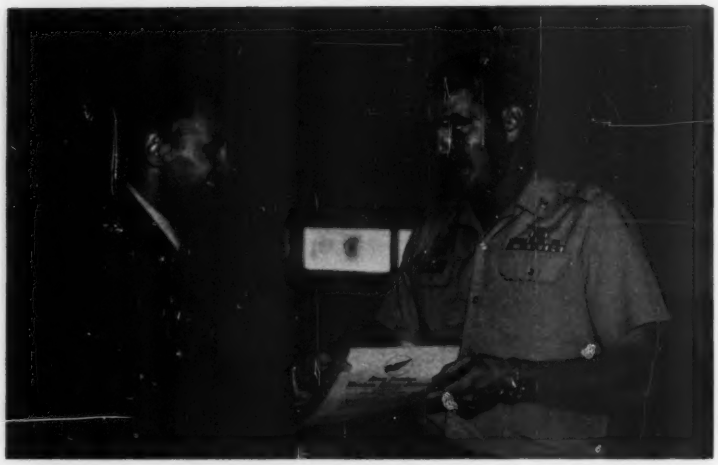
CORRESPONDENCE COURSE

USAAAVS has also considered those individuals who are not able to obtain a school quota. The Aviation Accident Prevention Management Correspondence Course provides training in aviation accident prevention management and familiarizes the student with the organization and structure of the Army aviation accident prevention program. Any commissioned officer, warrant officer, noncommissioned officer or DA civilian may enroll whose present or anticipated duty assignment is aviation oriented. The course consists of six subcourses totaling 35 hours. Upon completion, the student will receive a diploma. For further information, write the Commandant, U. S. Army Aviation School, P. O. Box J, Fort Rucker, AL 36360.

The problem of assisting people who are already doing a good job is not easy. USAAAVS has the job of training Army aviation personnel who have already achieved the lowest accident rate ever. This job calls for continual refinements to hazard prevention programs. The application of sound management principles to your safety program, with command emphasis and USAAAVS training, can produce even greater savings of our aviation assets and combat capabilities.

BROKEN WING AWARDS

PRESIDIO OF SAN FRANCISCO, CALIFORNIA—Colonel William I. Gordon, deputy commander of the U. S. Army Readiness Region IX (left), presents the Broken Wing Aviation Safety Award to CW3 Michael D. McGwin. CW3 McGwin was on a UH-1H night search and rescue mission in the vicinity of Sacramento, CA, when he experienced engine failure at 2,200 feet in his UH-1H. He turned the helicopter away from the city lights and autorotated without damage to a 100- by 200-foot field surrounded by trees and high tension wires.



INDIANAPOLIS, INDIANA—Major John E. Freeman (left) and CW2 Timothy J. Wright (center) receive the Broken Wing Aviation Safety Award from the Indiana Adjutant General, BG Alfred F. Ahner. The awards were presented to the pilots for landing helicopters during emergencies without injury to personnel in the aircraft or damage to the helicopters. MAJ Freeman was on an OH-58A training mission in the vicinity of Edinbury, IN, when his engine failed at 640 feet over unimproved terrain. He autorotated to a sod field scattered with 5-foot-tall gun targets and covered with tall grass. CW2 Wright was on an OH-58A administrative mission in the vicinity of Warren, IN, when he also experienced engine failure at 700 feet over unimproved sod terrain. He autorotated to a large unimproved sod field covered with tall grass and aligned on two sides by 50-foot trees.

Command/Supervision Error

All too frequently, I hear allegations that command/supervision is responsible for many accidents. Do accident investigations actually substantiate these allegations?—Aviation commander

Yes. "Risk management" errors made by commanders/supervisors from the first line through the highest echelon of command appear as cause factors all too frequently in accident reports. Let me illustrate with a combination of errors that was almost a tragedy. Fortunately, only an expensive aircraft was demolished and three men were injured as a result of the following risk management errors:

- An *uninstrumented* helicopter and a *noninstrument-rated* crew were selected to fly a weather check from an *uninstrumented landing* strip in obvious IFR conditions (even the tops of nearby trees were obscured by mist).
- There were flare pots outlining the landing "T," but they were not lit.
- One supervisor felt the weather check was necessary to back up any decision not to fly the mission.
- Unit personnel reported strong command pressure to complete assigned missions in less than VFR weather.

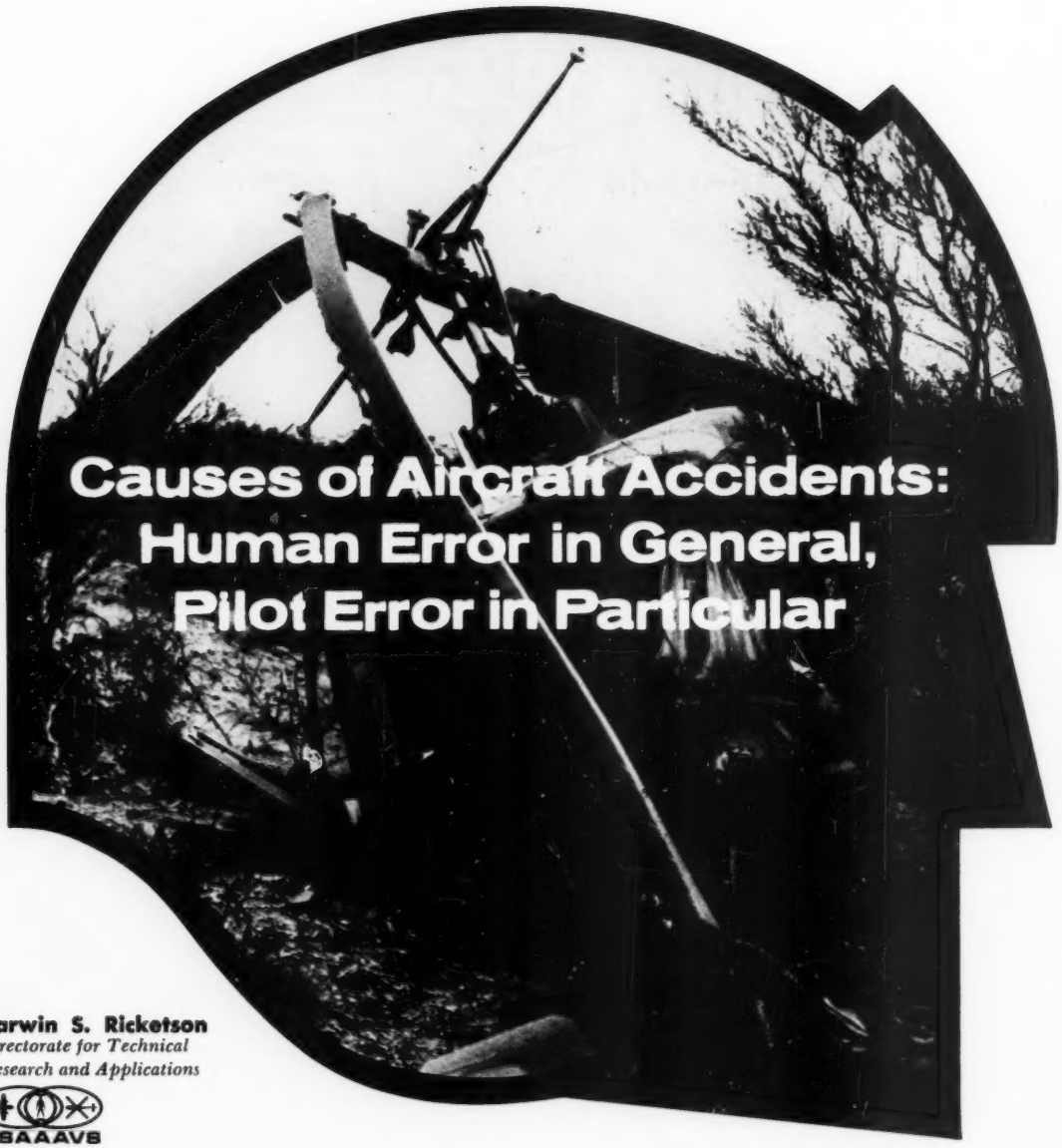
The Chief Advisor on Matters of Aviation Safety elects not to comment on these obviously human judgment errors, other than to call your attention to page 1 of this issue.

AR 95-1

My question concerns the paragraph in AR 95-1 which states: "Crewmembers accomplish oral callout and confirmation of checklist." The area in concern is the exterior check during the preflight of an aircraft. We had a discussion in my unit concerning the interpretation of the word crewmembers as used in this paragraph. Some felt that it referred to the crewmembers of the aircraft being inspected and that it would require at least two people to perform the preflight, one person to read out the checklist and the other to perform and call out the response orally. Others thought that it meant all crewmembers, Army-wide, performing a preflight were to have a checklist and to read the steps and make each check. This would mean one person could perform the preflight. Can you clarify this for us?—Aviator

When two crewmembers are available, both should be used for the preflight, starting, runup, takeoff, landing and shutdown checklists. The pilot/copilot combination for oral callout and confirmation of items on the individual checklists is by far the most desirable for continuity and accuracy. However, most Army aircraft can be flown with only one pilot on board, depending on the mission, and therefore will have only one crewmember to complete the required checklists. Local AR supplements and unit SOPs should further define crew requirements either by mission or aircraft type.

If you have a question concerning aviation accident prevention, write to
Commander, USAAAVS
ATTN: Orval Right
Fort Rucker, AL 36360



Causes of Aircraft Accidents: Human Error in General, Pilot Error in Particular

Darwin S. Ricketson
Directorate for Technical Research and Applications
USAAAVS

DURING THE 15-year period from 1958 to 1972, human error by itself or in combination with other factors caused or contributed to more Army aircraft accidents than any other factor. In fact, pilot error by itself was a factor in 80 percent of all accidents and cost an average of $58 million per

year in terms of injuries, fatalities and aircraft damage. When accidents caused or contributed to by supervisory and maintenance error are added, almost all accidents involve some human-error factor.

What is so striking about the human-error problem is its persistence. The proportion of accidents due to human error has not changed more than 10 percent in any of the last 15 years. However, in the same time span:

1. The orientation of aviation operations changed from peacetime to combat and back to peacetime.
2. Annual flight time ranged more than 5 million hours from the lowest to the highest year.
3. Annual accidents ranged more than 800 from the lowest to the highest year.

In sum, human error has been a large and stable cause of accidents in a very unstable aviation environment.

Man: Strongest and Weakest Element. The magnitude and persistence of human error as a cause of aircraft accidents might lead one to wonder about the quality of Army aviation personnel. Fortunately, the quality of personnel is not the problem. The problem is that most expect maximum mission performance from the aviation system and place demands on it accordingly. In truth, however, one or more of the basic system elements will be operating below maximum performance at any given time during the mission and it is this submaximum performance that causes or contributes to accidents.

In almost all instances man is the system element that causes or contributes to accidents by what he does/does not do or can/cannot do. This is true because man is simultaneously the strongest and weakest element in the aviation system. He is the *strongest* because he can learn, has diverse skills and knowledges, is adaptable and can share his attention between several on-going tasks. These attributes are why he has been made the overall manager and manipulator of the aviation system. He is the *weakest* because his performance is unreliable, i.e., he cannot perform the same task in the same manner time and time again. His performance is unreliable because it is subject to the influences of his widely varying psychological and physiological limitations. His performance is also unreliable because of his unique troubleshooting role; when anything goes wrong in the system, he must continue his normal tasks and simultaneously correct or adjust for the abnormal condition within the system. It is not surprising then that man, who has the most important and demanding role in the system, is unreliable in the performance of his duties and this unreliable performance causes or contributes to more aircraft accidents than the performance of any other element in the aviation system.

The Human-Error Accident. We have seen that human error results from man's psychological and physiological limitations and his demanding role in the aviation system. The next step is to show what causes man's limitations to be exceeded, his system role to be overloaded and human-error accidents to result.

Figure 1 provides a functional definition of the human-error accident. Items 1 through 8 are the basic man-machine-environment elements of the aviation system. When these elements get out of tolerance, an overload (item 9) is put on man's system role (item 10) in that he must continue to perform his normal tasks while correcting or adjusting for the abnormal system condition. When this overload becomes too large or occurs at a critical time, man starts making errors (item 11) in his normal tasks and/or in his handling of the abnormal system condition. Most of these errors slip by without causing an accident (item 12). But, when lady luck frowns, the error results in an accident (item 13).

It should be emphasized that the overload (item 9) placed on man's role in the system (item 10):

1. *May originate with man* because of his inherent psychological (item 7) and physiological (item 9) limitations, e.g., distraction and fatigue, or
2. *May be imposed on man* because of his managerial/troubleshooting duties, e.g., improper maintenance (item 3) can lead to an overload (item 9) in the form of equipment/vehicle failure that man must correct or adjust for, or
3. *May be both* imposed on the man and originated by the man, e.g., improper supervisory practices (item 6) may allow personnel to be worked too long or too hard which produces fatigue (item 8) and a system overload (item 9) in the form of a decreased capacity of the man to perform his duties.

In sum, human error results from man's system role being overloaded and this overload can be the fault of man, other system elements or a combination of both.

Common Human-Error Causes. Since we are all concerned with preventing aircraft accidents, it is highly desirable that we determine the most frequent or common ways man's role in the system is over-

loaded, thereby resulting in accidents. A recently completed 2-year study of pilot-error accidents was designed to do just that, i.e., discover the common causes of these accidents. A proven research technique, factor analyses, was adapted to accommodate Army aircraft accident data and the results revealed what everybody "knew" but nobody was able to *prove*, i.e., errors in the basic fundamentals of aviation cause accidents.

Briefly, 1,520 helicopter and 452 airplane pilot-error accidents were factor analyzed. Nine[1] factors were disclosed that accounted for 96 percent of the helicopter *and* airplane accidents. These nine factors are listed below with a description of each.

1. Disorientation. RW—6%, FW—6%[2]: This pilot-error event occurred mainly during the in-flight or landing phases of night missions. In terms of injuries, fatalities and aircraft damage cost, these mishaps were catastrophic; which indicates the pilots were unaware of or unable to determine their geographic or spatial orientation. Most of these mishaps occurred under visual flight rules (VFR) clearances, suggesting pilots expected to maintain visual contact with the ground or horizon. *However, the presence of inadequate weather analysis indicates atmospheric obscuration occurred which the pilots should have successfully dealt with either before or after it was encountered.*

2. Overconfidence. RW—8%, FW—7%: Most of these pilot-error events occurred during landing and appear to focus on a transitory state of the individual which encourages unnecessary risk-taking. This unnecessary risk-taking may be due to the pilot's unrealistic overconfidence in his own ability, ability of others and/or ability of the aircraft. Regardless of the object, *the pilot's overconfidence is accompanied by a violation of flight discipline which may have been due to excessive motivation to succeed.*

3. Procedural Decisions. RW—19%, FW—14%: This pilot-error event involved faulty decision-making regarding selection of the most appropriate procedure from alternatives. In other words, *the pilot chose an incorrect procedure because he improperly assessed the flight situation.*

4. Crew Coordination. RW—11%, FW—14%: This factor describes an error event attributed to unsuccessful accomplishment of activities requiring coordination between the pilot and other crewmembers. The high loading of inadequate briefing indicates the assignment of crew responsibilities was not performed or was performed incorrectly. *The high proportion of experienced aircraft commanders suggests they were responsible for the inadequate briefing and points to the importance of thorough briefings regardless of crew experience.*

5. Precise Multiple Control. RW—21%, FW—17%: The high proportion of these cases occurring during landing suggests the largest component of positioning skill involved is a precise rate-of-closure judgment, i.e., integrated judgment of aircraft speed and distance to touchdown point. The presence of delay in taking necessary action may be interpreted in the context of training missions during which *the instructor pilot misjudged the rate of closure and delayed taking control of the aircraft from the student to a point where recovery without aircraft damage was unlikely.* In terms of injuries, fatalities and aircraft damage cost, precise multiple control mishaps were the least severe of all helicopter cases.

6. Limited Experience. RW—9%, FW—13%: This error event appears to describe a general class of mistakes attributable to pilots with absolutely or relatively low levels of experience. Most of these mishaps occurred during landing and are strongly related to the performance of autorotations in practice or actual emergencies. In general, helicopter limited experience mishaps cluster in a training group and a smaller combat group. The training group is *characterized by students in the process of becoming rated pilots or rated pilots in the training process of transitioning from one helicopter to another.*

7. Task Oversaturation. RW—8%, FW—13%: The mishaps represented by task oversaturation involved a degradation of the pilot's ability to share his time/attention among required tasks. These

[1] *Faulty preflight or failure to perform preflight was not considered in this review. We all should know by now that this item can do you in, so we must be professional enough to preflight by-the-book.*

[2] *Percent of the total rotary wing or fixed wing accidents attributed to each factor.*

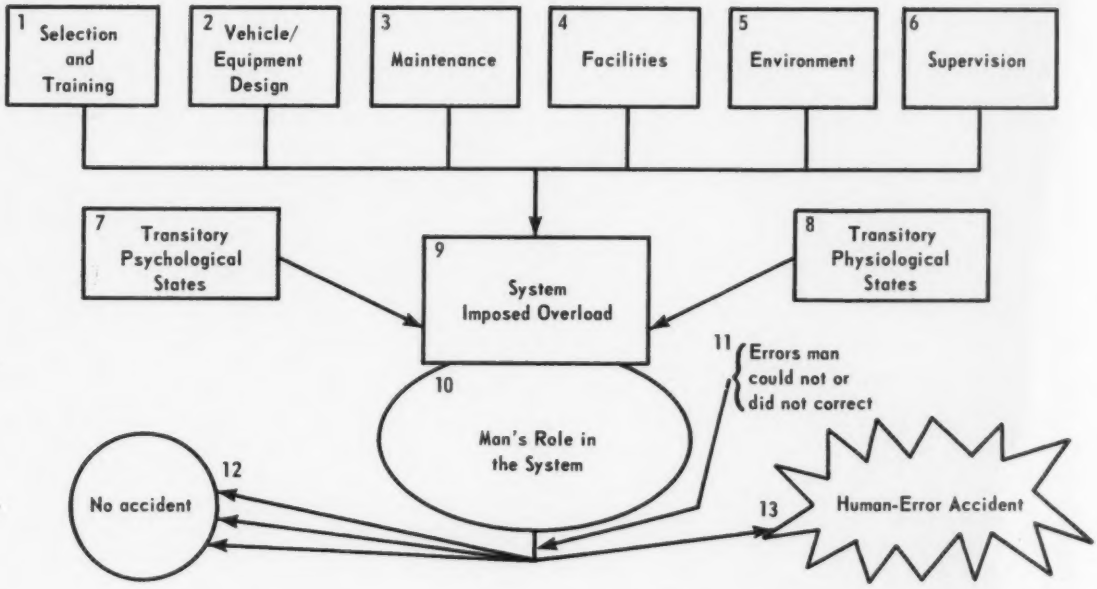


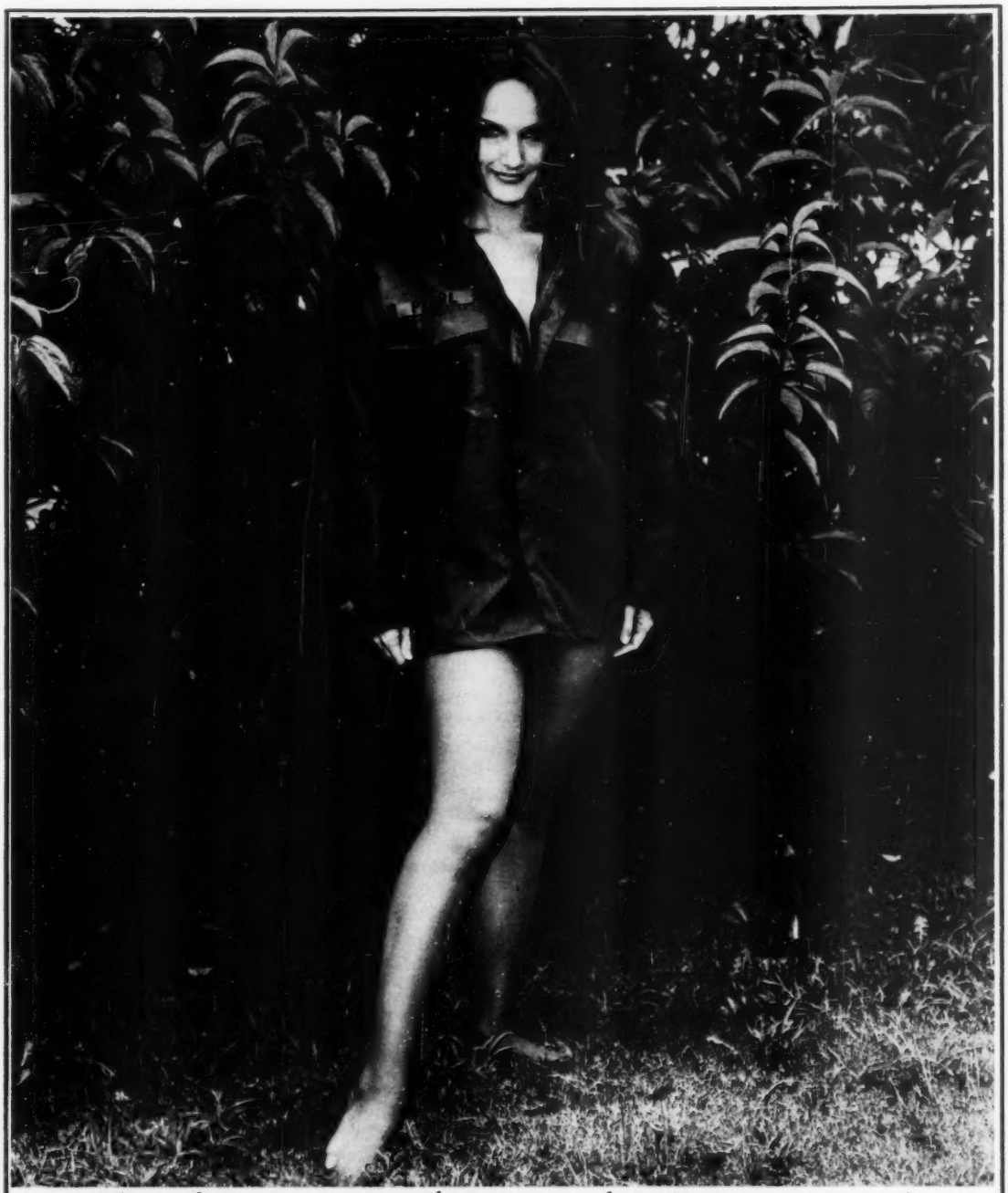
FIGURE 1. Functional definition of human-error accident

cases appear distinguishable according to different causes of the pilot's degraded ability. The first situation appears to center on *training missions during which the student and/or instructor is so apprehensive about a critical task, such as landing, that attention becomes focused on one aspect of the task at the expense of other aspects. The second situation concerns combat missions during which a malfunction, emergency or other abnormal condition arises.*

8. Attention. RW—13%, FW—8%: The major component of this pilot-error event is inadequate attention of experienced pilots in terms of task vigilance or readiness to respond. The most frequent occurs during the landing phase of training missions. Experienced instructor pilots maintaining inadequate vigilance or readiness to respond play a large role in these mishaps. *Confusion of controls apparently occurs when the instructor finally realizes the extent to which the flight situation has deteriorated and, in the rush to assume control of the aircraft, manipulates the wrong control or applies control actions to a greater or lesser extent than required.*

9. Other Weather. RW—5%, FW—15%: These mishaps occurred during operational missions in which weather conditions such as wind, ice or hail influenced the pilot's ability to perform the task at hand. The high proportion of autorotations and landings suggests *pilots inadequately assessed the direction or magnitude of winds and made their approaches downwind or were caught in unexpected crosswinds.*

Conclusions. Pilot error in one form or another is a factor which causes the majority of Army aviation accidents. Research has revealed that the nine basic cause factors discussed in this article account for 96 percent of all these pilot-error-related accidents. Therefore, it can be concluded that if commanders, aviators and aviation safety officers in their aviation accident prevention programs would place the priority of effort on these nine factors then the accidents related to pilot error could be significantly decreased. THE CHALLENGE IS YOURS. To date, this challenge has not been met.



If you have a question about personal equipment or rescue/ survival gear, write Pearl, USAAAVS, Ft. Rucker, AL 36360

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

Life Support Equipment Retrieval Program

Change 4, AR 95-5, dated 29 January 1973, establishes the Army's Life Support Equipment (LSE) Retrieval Program. This regulation directs that all life support and personal equipment which was damaged or partially damaged during an aircraft accident and which caused or prevented injury be forwarded to the United States Army Aeromedical Research Laboratory (USAARL), Ft. Rucker, AL, for analysis. Failure modes of the equipment (helmets, restraint systems, protective clothing, etc.) received for analysis are determined and correlated with the injury/autopsy report and aircraft structural deformation contained in the aircraft accident investigation report. Information obtained from the analysis is used to identify areas of LSE deficiencies, to aid in the product improvement of this equipment and to develop design criteria for future LSE.

After an accident investigation has been completed, the president of the accident investigation board will ensure that damaged LSE is itemized on DD Form 200 (Report of Survey) or DA Form 444 (Inventory Adjustment Report) in accordance with AR 735-11. The equipment includes but is not necessarily limited to helmets, flight suits, gloves, boots, oxygen equipment (e.g., masks and hoses), parachutes and life preservers. Body armor will not be itemized. Then, he will arrange for shipment of the equipment for laboratory analysis to the Commander, USAARL, P. O. Box 577, Ft. Rucker, AL 36360.

Problem areas which are presently being investigated are seat belt attachment points which may constitute a dangerously weak link in the restraint chain of certain Army aircraft and the visor housing mount on the helmet which, in its present configuration, seems to be acting as an energy sink, concentrating rather than distributing impact forces.

USAARL is currently involved in studies of LSE which will enhance aviation safety. These studies include ejection/extraction systems, thermal protective clothing and helmet design and evaluation, and the functioning of LSE in an aircraft accident environment. It is through studies such as these that the risk of injury and loss of life can be reduced.

U-21A Oxygen System

Our battalion recently ordered some oxygen masks to be used in the U-21A, but when they were received they were accompanied by OV-1 fittings which would not fit the U-21A system.

Request any information on the proper oxygen masks, the plastic holder, microphone and bayonet assembly as we are unable to properly use the oxygen system in our aircraft.—Supply officer

The U-21A should be installed with the MD-2 dilutor/demand oxygen regulators for the pilot and copilot. The below listed oxygen masks and adaptor/harness retention kits are compatible with the MD-2 regulator. Communications are achieved through the microphone in the mask which connects to the cord of the SPH-4.

Mask

Oxygen, mask, small, FSN 1660-809-0391
Oxygen, mask, medium, FSN 1660-809-0379
Oxygen, mask, large, FSN 1660-809-0390

Adaptor and Harness/Retention Kit

Adaptor and harness, small, FSN 1660-179-1190
Adaptor and harness, medium, FSN 1660-179-1191
Adaptor and harness, large, FSN 1660-179-1194

Note: The above adaptor and harness kits attach the oxygen mask to the SPH-4 helmet.

Oxygen for passengers in the rear compartment is a continuous flow system. For this area, the disposable plastic mask (FSN 1660-902-5308) is available. This mask is supplied only in one size and has no means of electronic communication.

The oxygen system in the OV-1 and U-21A both use the MD-2 regulator and oxygen masks listed above. In the event your aircraft have regulators different from the MD-2, please advise U. S. Army Agency for Aviation Safety of the type installed.

USAASO Sez

The U. S. Army Aeronautical Services Office discusses

The air would be a better place for all of us to be,
If maps and charts could keep apace with changes that you see.
When problems with your pubs arise and rules and regs get dim,
Don't look at God and fuss with Him just send a Comm Card in.

☐ CORRECTION ☒ SUGGESTION ☐ PLANNING ☐ TERMINAL ☐ ENROUTE

These cards are available at your unit operations. Make yourself a helping part of the system instead of being a totally quiet birdman. They are self addressed, go around all channels and get direct action. If you are lonely, consider that if nothing else your suggestion will even be rewarded with a letter in return.

DATE	NAME AND GRADE	ORG., ADDRESS AND PHONE NO.
Anytime	*Bet R. Product*	*Anywhere*

DA FORM 3588, 1 Apr 70

WAIT—AND BALANCE PROPERLY!

(It May Give You A Real Lift)

Takeoff a little mushy? Pushing hard on that yoke—is no joke—when an overloaded cargo compartment puts the nose where it shouldn't be. Did you supervise the loading pattern and personally check the weight of all baggage put aboard? You can believe it—there is nothing abstract about the concrete aspects of some people's gear. If in doubt, make sure you inspect and if necessary heft the hand carried baggage to determine if your pax is carrying an ax like a geologist and instead of soiled socks, has some fine specimens of rocks in that well-worn valise. The facts of life on cube, density, mass and matter really does matter and can be important to your longevity.

Check your Form F or otherwise carefully check the weight and balance limitations prescribed for your bird. Your attention to this detail may cause some delay—but it could prevent spoiling your whole day.

☆ U.S. Government Printing Office 1973—746-161/5

At Fort Rucker

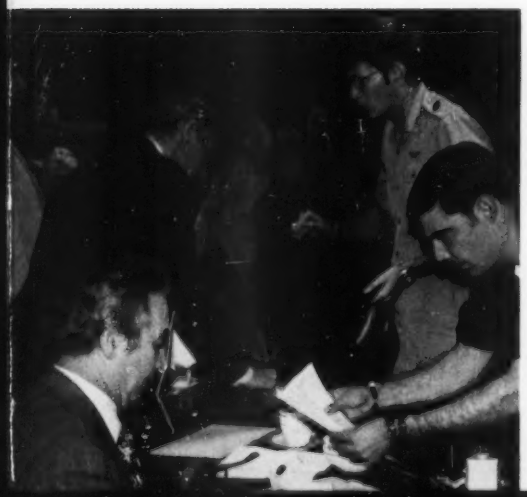
Flight Pay Hearings

AS FLIGHT PAY legislation was coming to a head, members of Congress' House of Representatives Armed Services subcommittee number four, chaired by Representative Samuel S. Stratton (D, NY) visited the U. S. Army Aviation Center and School at Fort Rucker, Alabama, to talk with Army aviators about House of Representatives bill number 8593 and other flight/incentive pay proposals.

The subcommittee held separate hearings, interviewing both senior and younger commissioned officers. The Army's aviation warrant officers also got equal time to present their views on incentive pay.

Members of House Armed Services subcommittee number four who held hearings at Fort Rucker were Representatives William Dickinson (R, AL), Bill Nichols (D, AL), Les Aspin (D, WI), Bill Young (R, FL) and staff member John Ford. The congressmen interviewed Navy carrier pilots and Air Force pilots prior to their stop at the Army Aviation School and were scheduled to meet with Marine Corps fliers before returning to Washington, DC.

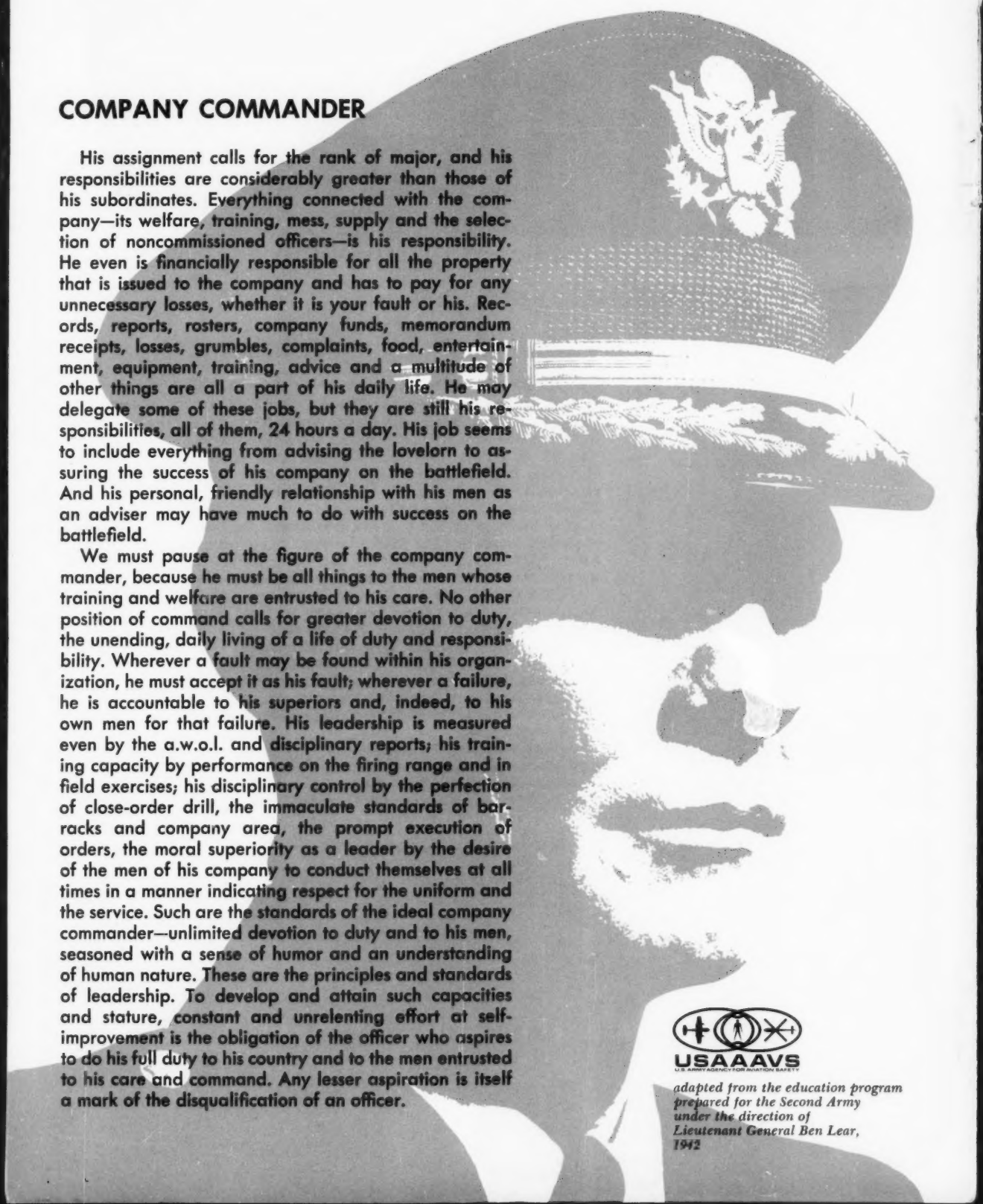
Before leaving Fort Rucker, the congressional delegation received a briefing and demonstration of Army tactical flying in the nap-of-the-earth environment and helicopter firepower capabilities.



COMPANY COMMANDER

His assignment calls for the rank of major, and his responsibilities are considerably greater than those of his subordinates. Everything connected with the company—its welfare, training, mess, supply and the selection of noncommissioned officers—is his responsibility. He even is financially responsible for all the property that is issued to the company and has to pay for any unnecessary losses, whether it is your fault or his. Records, reports, rosters, company funds, memorandum receipts, losses, grumbles, complaints, food, entertainment, equipment, training, advice and a multitude of other things are all a part of his daily life. He may delegate some of these jobs, but they are still his responsibilities, all of them, 24 hours a day. His job seems to include everything from advising the lovelorn to assuring the success of his company on the battlefield. And his personal, friendly relationship with his men as an adviser may have much to do with success on the battlefield.

We must pause at the figure of the company commander, because he must be all things to the men whose training and welfare are entrusted to his care. No other position of command calls for greater devotion to duty, the unending, daily living of a life of duty and responsibility. Wherever a fault may be found within his organization, he must accept it as his fault; wherever a failure, he is accountable to his superiors and, indeed, to his own men for that failure. His leadership is measured even by the a.w.o.l. and disciplinary reports; his training capacity by performance on the firing range and in field exercises; his disciplinary control by the perfection of close-order drill, the immaculate standards of barracks and company area, the prompt execution of orders, the moral superiority as a leader by the desire of the men of his company to conduct themselves at all times in a manner indicating respect for the uniform and the service. Such are the standards of the ideal company commander—unlimited devotion to duty and to his men, seasoned with a sense of humor and an understanding of human nature. These are the principles and standards of leadership. To develop and attain such capacities and stature, constant and unrelenting effort at self-improvement is the obligation of the officer who aspires to do his full duty to his country and to the men entrusted to his care and command. Any lesser aspiration is itself a mark of the disqualification of an officer.



USAAAVS
U.S. ARMY AGENCY FOR AVIATION SAFETY

adapted from the education program prepared for the Second Army under the direction of Lieutenant General Ben Lear, 1942